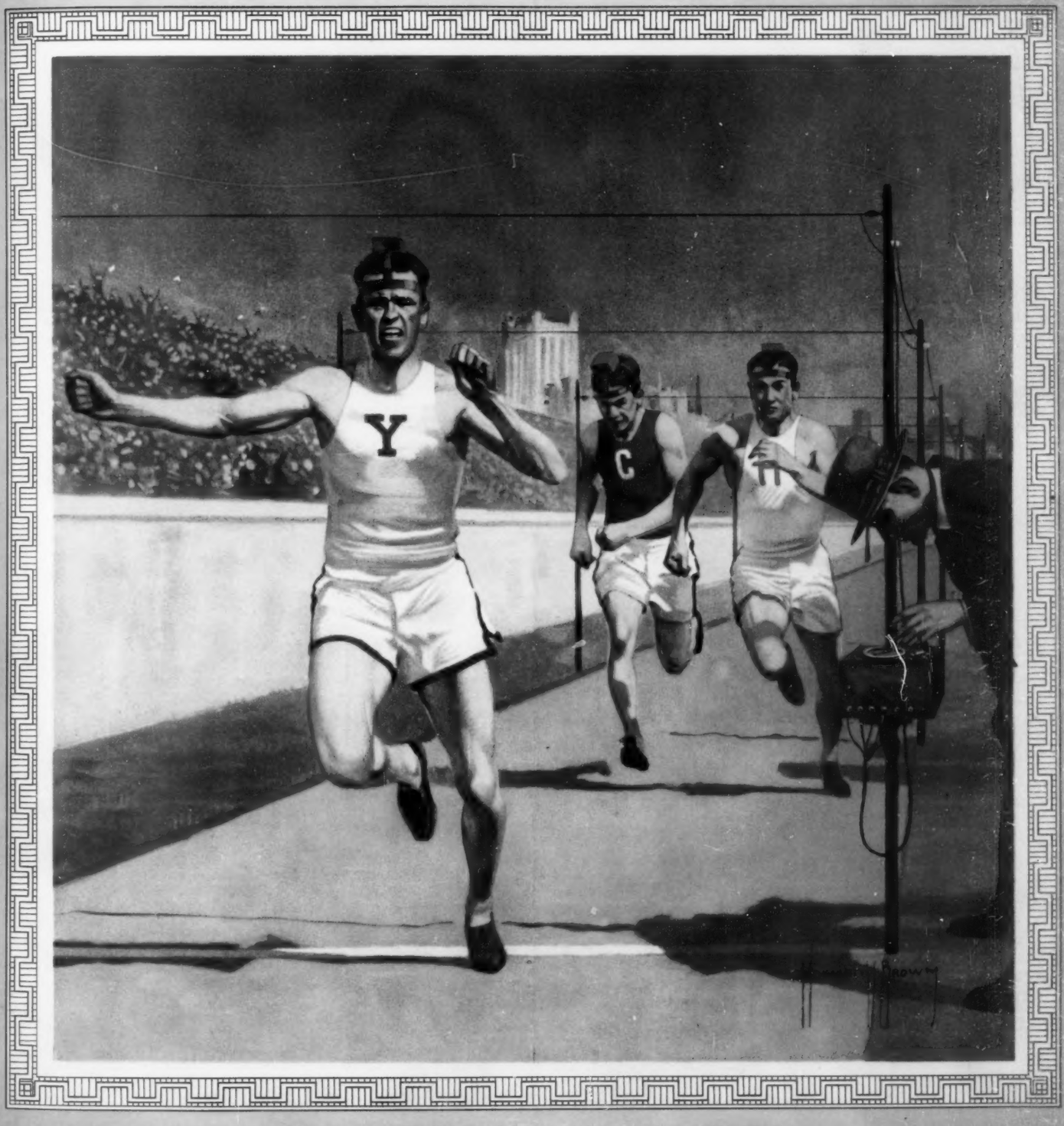
SCIENTIFIC AMERICAN

APRIL 1926



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THE SCIENTIFIC AMERICAN, April, 1926. Volume 144, Number 4. Published monthly by Scientific American Publishing Company, at 233 Broadway, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

—and now at Monte Carlo

THOSE who have been in Europe during the past few seasons remember the car beauty contests which have been a fad at the famous watering places on the Continent. *Concours d'Elégance-Automobiles* they are called in France.

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Such international acclaim confirms America's verdict—that the unchanging beauty and distinction of Packard lines have yet to be equaled or surpassed.

PACKARD

Ask the man who owns one

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, APRIL, 1926 EIGHTY-SECOND YEAR

PIONEERING

SOMETIMES a man fails to lead because he runs too far ahead of his fellows. Often this is true of inventors. A splendid example of this was recounted recently at the dinner of the Edison Pioneers in honor of Thomas A. Edison's seventy-ninth birthday.

"Mr. Edison was too early with radio, discovering the spark or wave in 1875," said the Robert A. Carter, who was associated with the wizard of Menlo Park, forty years ago. "In that same year he built a set and published it in the Scientific American, 12 years before Hertz and 22 years before Marconi."

Just as in literature a man spins a thrilling story, only to find that Kipling said the same thing long before him, so the scientist, exploring what he believes to be a virgin wilderness, comes often upon the footprints of Edison, the most prolific inventor the world has yet seen.

HABIT

ON July 15, 1913, the circulation department of the Scientific American sent to a subscriber in the state of Washington, a bill for $3, for a renewal of his subscription. The magazine was a weekly then and cost $3 a year.

Just the other day that bill came back and with it a check for $4.

There is nothing out of the ordinary in the fact that he renewed his subscription. Most subscribers do renew. Nor is it surprising that his renewal did not come back promptly. Once in a while a reader does stray from the path of science. The unusual thing is that the old member of our family of readers waited 13 years before coming back.

The habit of keeping up with science has this danger in it—once it gets you you never are content to live in ignorance again.

NEWS?

THE newspapers recently printed a dispatch from Washington announcing that science "has at last discovered what historians have termed the great sea serpent." The announcement caused Mr. B. A. Broome to write to the New York *Sun* as follows:

"This was discovered and carefully explained forty years ago by Daniel Carter Beard. His account was published in the Scientific American some time in 1885 or 1886 and with it was a large woodcut of a drawing Mr. Beard had made to illustrate how a giant squid would be taken for a sea serpent by anyone unfamiliar with the appearance of a squid at the surface of the water."

All of which goes to show that you really can get the news about science by reading the newspapers—if you only wait long enough.

In This Issue

Uncovering Ancient Greece
Thrilling discoveries of the ancient Greek civilization have recently been made by a group of Americans excavating in Corinth. Commencing on page 221, Dr. T. L. Shear, of Princeton University, tells of their finds.

Your Property Is Being Wasted
J. Bernard Walker this month fires the opening gun in a series of attacks on the squandering of our national resources. Twenty-five billion cubic feet is the drain on your forests every year, he declares, and much of it is needless waste.

An Athlete Is a Living Machine
When an athlete sprints or rows a race, he expends energy at a definite rate which science has found a way to measure. On page 224 a noted physiologist tells you how it is done. More interesting than the sports page.

What Causes Goiter?
Iodine deficiency, says science. Parts of our country lack iodine but there is an easy way to get it. Commencing on page 248, Dr. J. W. Turrentine tells how.

A New Kind of Radio Wave
Experiments prove that the earth's magnetism causes radio waves to turn in the upper air like a twisted ribbon, a discovery which may account for "fading." To remedy this condition, broadcasting stations may use various wavelengths at different hours. See page 234.

MORE THAN 175 PICTURES

Complete table of contents will be found on page 287.

For Next Month

Whence Came Civilization?
Did civilization begin in one place and spread, or did it arise independently in many places? Most anthropologists take the latter view, but a noted authority, Prof. G. Elliot Smith, presents strong evidence for the opposite view.

Getting Rid of Mosquitos
One kind of mosquito causes malaria. One tiny kind of fish eats that kind of mosquito with avidity. Next month a famous naturalist, Dr. David Starr Jordan will tell how it is planned to set this mosquito-hungry fish to work.

How to Correct Auditoriums
Reverberations, echoes and similar faults make hearing difficult in churches, schools and auditoriums all over the country. Next month, Prof. H. H. Sheldon, Professor of Physics at New York University, will begin a series of practical scientific articles by telling how you can correct such auditoriums.

Other articles on Ancient Man; How Can We Produce Scientific Workers?; The New Cosmology; Anti-aircraft Firing Methods; Nature Faking; American Diamond Mines; Contour Measuring; Methods of Wood Preservation; Radio; Astronomy.

MORE THAN 175 PICTURES

DOCTORS

TOO long has the physician been looked upon as a sort of middleman between the sick person and the undertaker. At last, however, a new conception of the function of the doctor is arising. Dr. Wendell C. Phillips, president of the American Medical Association, voices it.

"What will the doctor of the future be?" he asks. "He must have different training. Is treatment the sole function of the doctor of the future? No. He must know preventive medicine. He must keep people well. We are not going to have the diseases we had before."

No small part of the job of the doctor of the future, however, will be to convince his patients that they must not wait for an emergency to call him in. Human nature being what it is, the proportion of the population who will summon a physician, and pay him, when they are feeling well is just about enough to support 27½ doctors.

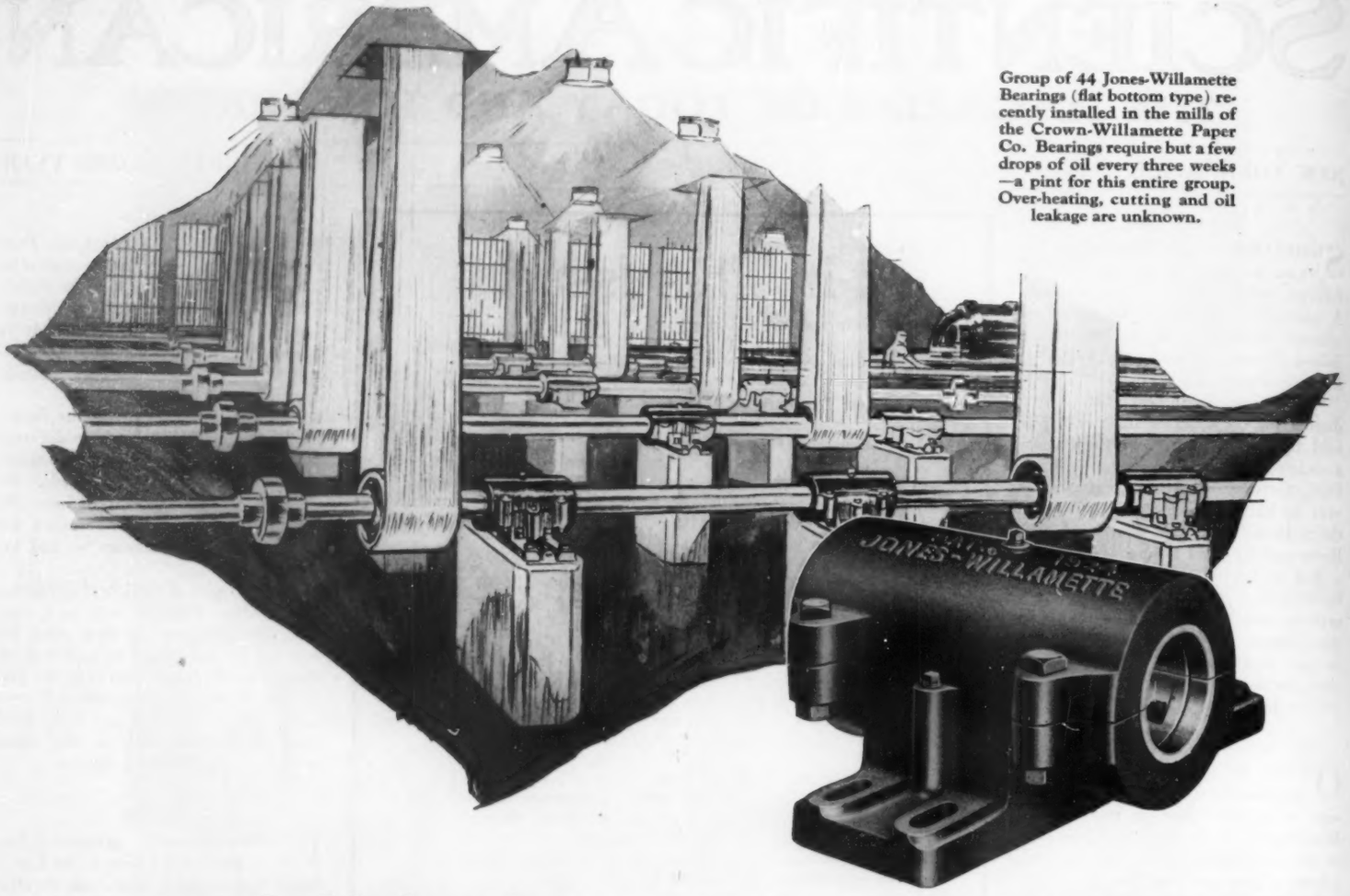
TAXES

IF you are disposed to grumble at having to pay annual taxes to the United States Government, take such comfort as you can from the fact that there are others who are more heavily hit than yourself. Thus we learn from the president of the New York Central Railroad that the tax collectors get more from the American railroads than do the stockholders. Says he, "It takes the earnings of 3,000 miles of our lines to pay the taxes. In other words, one mile out of every four of our 12,000 miles is working for the Government." This is one of the heavy burdens that are being carried by the railroads in their heroic effort to show those dividends of six percent, which are necessary if they are to raise the greatly needed capital for improvements and extensions.

THUGS

BETWEEN bronze book ends on a gold-embroidered cloth, covering a mahogany table in a lavish New York apartment, stood complete editions of Shakespeare, Boswell's "Life of Johnson," a history of England and a treatise on higher mathematics. Here, say the New York police, they found the headquarters of one of the best organized and most dangerous gangs of thugs.

How is it that, obviously steeped in letters and in science, these master criminals were caught by police of a supposedly far lesser degree of culture? Perhaps this is the answer: Such science as the bandits had was for speculative purposes only; what science the police had was used.



Group of 44 Jones-Willamette Bearings (flat bottom type) recently installed in the mills of the Crown-Willamette Paper Co. Bearings require but a few drops of oil every three weeks —a pint for this entire group. Over-heating, cutting and oil leakage are unknown.

This *remarkable bearing* cuts friction in transmission shafting

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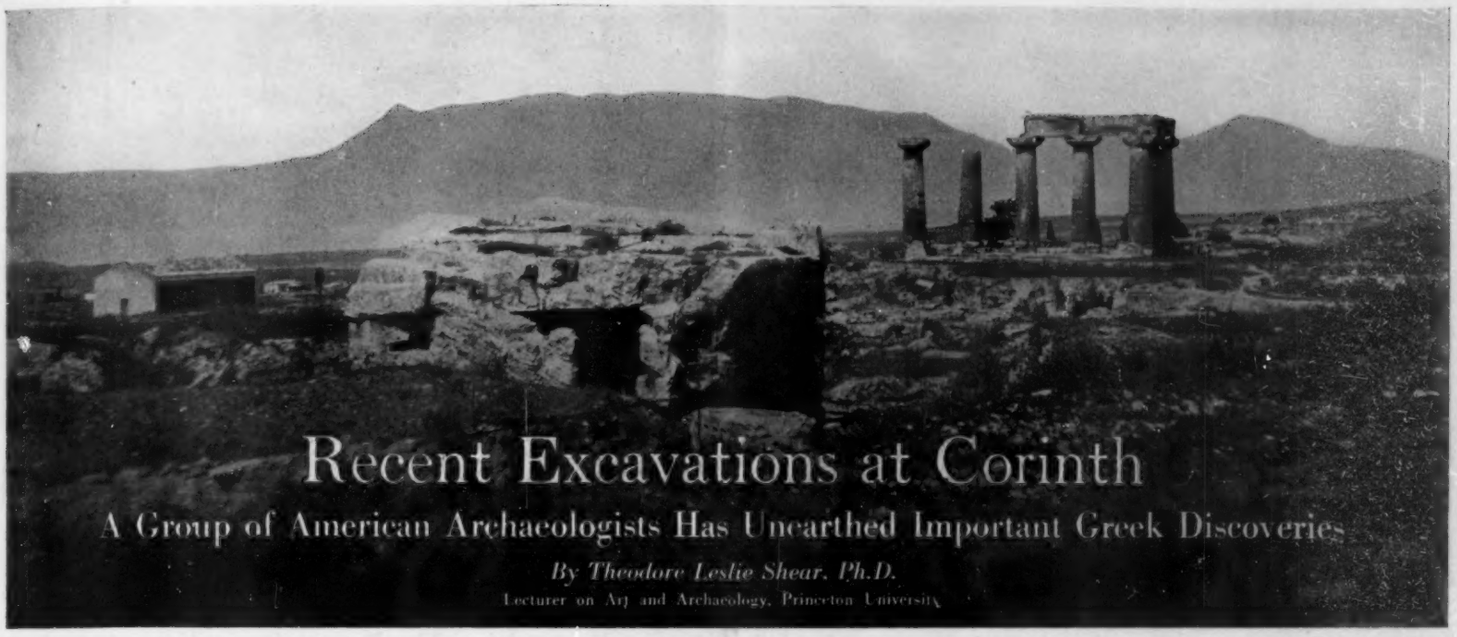


Recent Excavations at Corinth

A Group of American Archaeologists Has Unearthed Important Greek Discoveries

By Theodore Leslie Shear, Ph.D.
Lecturer on Art and Archaeology, Princeton University

BECAUSE of the political, industrial and artistic importance of "wealthy Corinth" in antiquity, the American School of Classical Studies at Athens was attracted to undertake archaeological exploration on this site in 1896. Since then this work has been conducted by the School from time to time with important results.

After a cessation of operations for several years excavations were resumed in the spring of 1925, under the general direction of Dr. B. H. Hill, Director of the School. The task of clearing the great theatre was in the hands of the writer, whose wife was the artist of the expedition. Other members of the staff were Richard Stillwell, architect, and two Fellows of the School, Oscar Broneer and Alexander Robinson.

Preparatory work at the theatre was begun early last March and excavation was made above a section of the site included within the west entrance to the orchestra. Small finds, such as bronze coins, were constantly being made, as well as numerous other objects, among which were lamps and fragments of marble and of terra-cotta. All these objects were in the loose earth above the place where the seats of the auditorium should have been; but though the earth was here removed to hard-pan, at a depth of over fifteen feet no part of the structure appeared.

The area of work was then shifted to the southeast, and excavation was resumed at a spot which, according to hypothetical plans, should have been above the edge of the orchestra circle, south of its central point. After the upper layers of earth had been removed the digging was done with the most minute care by small groups of men under watchful scrutiny. Every stone larger than a pebble was cleared on all sides before its removal was permitted, and each section of hard earth was left untouched until a probing with a knife showed its exact nature.

Colors Still Bright and Fresh

This slow and careful method had its abundant reward when the fragile nature of an important discovery of unique character that was presently made became apparent. About twenty-five feet below the surface of the ground a solid mass of hard-pan, the face of which was decorated with painted plaster, was uncovered. As this was at the bottom of a narrow pit, it was some time before the subject of the large-scale painting was revealed, but the laborers worked with zeal, and before the end of the season a total length of forty-five feet of painted wall had been cleared. The discovery of any evidences of a bygone civilization famous in history and literature is an exciting event, but it is particularly thrilling, after digging through more than thirty feet of unproductive dirt, to come on a polychrome monument with its colors bright and fresh.

At a point in the circumference of the circle of the orchestra of the theater, opposite the center of the stage, is an opening, 3 feet 4 inches wide, on either side of which a wall is preserved to the height of 5½ feet. The front of the wall is covered with stucco on which are painted groups of life-size figures depicted as engaged in combats with lions. The main field of the picture, against which the figures are painted, is blue; below this are bands in two shades of yellow apparently representing the floor or ground on which the action takes place. This is bordered by a narrow band of dark blue, which, in turn,. is separated by a pale pink strip from the broad outer border of dark red. This triple-colored border bounds the frieze, for it turns the corner and extends upwards along the vertical edge of the wall on either side of the opening.

OFFERING TO THE TEMPLE OF ATHENA
Metal bowl supported by ivory lions. Reconstruction was made by Prentice Duell

From a water-color by N. C. Shear
MOSAIC FLOOR IN THE ROMAN VILLA
Head of Bacchus surrounded by intricate designs made with tiny stones of many colors

From a drawing by N. C. Shear
A TERRA-COTTA VOTIVE PLAQUE
Of the 4th Century B. C. A satyr in a startled attitude before a seated youth

THE EXCAVATIONS IN PROGRESS

Digging down to the orchestra of the theatre. In the left background is the temple of Apollo

LOOKING FOR THE TEMPLE OF ATHENA

A Byzantine house was uncovered in which was found a large jar of green glazed ware

On the left as one faces the passage is represented, as far as the wall has been uncovered (23 feet), a group of two gladiators fighting a lion. At the end of the wall, a man is standing, with his back to the spectator, facing a lion charging on him from the left. His feet are far apart, his knees are bent and he seems in the attitude of one poising a spear. Unfortunately the figure, like the others so far discovered, is cut off at the waist and the upper part is missing. The man is clad in a long purple undergarment, above which is a white cloak that is fastened by a rosette on the left knee. From the character of the costume it is evident that he represents some official either of the city or of the games. But whatever his identity may be, he is engaged with a doughty adversary in the huge tawny lion, which is rushing upon him in full course with both forelegs raised. Without doubt he has confidence in his own weapon and also in his companion, who stands behind the lion, facing the spectator, with his muscles tense and about to hurl his own lance at the beast.

On a section of wall of equal length, which was uncovered on the right side of the passage, the group again consists of two gladiators and a lion, but the figures are differently arranged. The first man, next to the edge, is running to the spectator's left, and apparently away from the combat, which the gladiator behind him is waging with a lion that advances on his left. These men are dressed in one short garment, and have white sandals and white bands below the knees. It is difficult to realize the magnificence of this wall, which, when complete, was nearly nine feet high, and presumably extended around the entire circuit of the orchestra.

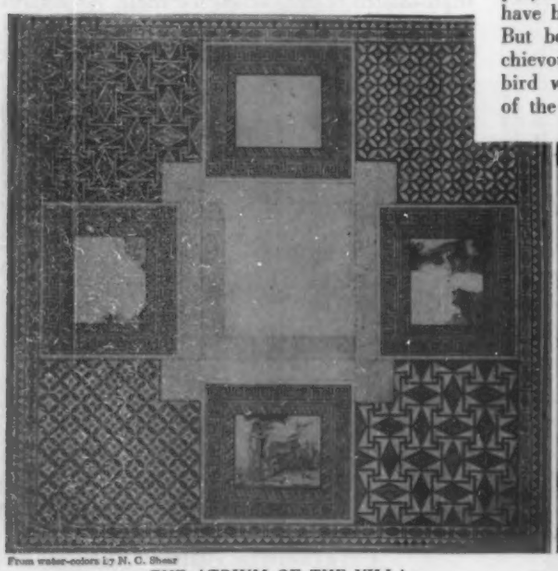
As the painted structure is built on the lines of the ancient Greek theatre, its history may be tentatively suggested. When the new colonists began to rebuild the city after the decree of 46 B. C., they used, as far as possible, the remains of former buildings. In the case of the theatre, the structural elements were available, but the plan of the lower part was altered to provide an arena suitable for gladiatorial contests. This alteration was accomplished by removing some of the lower rows of seats, and by cutting the slope of the hill back to a high wall, which would protect the spectators from the contesting men and beasts, and at the same time enlarge the arena. With a liberal allowance of time for building activity in the restored city the date of this construction might be reasonably placed between 25 B. C. and 25 A. D.

Proximity of Temple Indicated

As Herodes Atticus, in the second century A. D., erected the covered odeion near the theatre, it is possible that the reconstruction of the theatre itself was effected at the same time. This extraordinary polychromy is not mentioned by Pausanias and may have been already invisible at the time of his visit. But before it was covered from sight, some mischievous boy had scratched crudely in the stucco a bird with long feathers standing directly in front of the charging lion on the left wall, and above it printed his name in Greek letters. The major task of next season's campaign will be the uncovering of the remaining 300 feet of this remarkable wall.

When Pausanias describes his visit to the theatre section of Corinth, he specifically states that close to the theatre was located the sanctuary of Athena, the Bridler of Pegasus. In a search for this site, a trench was dug 25 meters long and 5 meters wide, running east and west along the Sicyon road, southeast of the theatre. Although the position of the sanctuary has not yet been definitely located, sufficient remains were found to prove the proximity of a temple, and excavations will be continued.

Among the objects discovered in this search for the Athena temple were several of the most important finds of the season. These included a deposit of small bowls, 160 in number, of which many were packed in superimposed piles, and all were evidently buried with care, as was frequently done with cheap, superfluous offerings when the treasury of a temple became overcrowded. Near this large cache of bowls were many ivory pins, which might have been appropriately dedicated to a female deity, and everywhere were vases and fragments of pottery of many periods. A lovely object that dates from the end of the 5th or the beginning of the 4th century B. C. is a small terra-cotta votive tablet with a representation in relief of a satyr dancing before a seated youth, perhaps Dionysus. The accurate modeling of



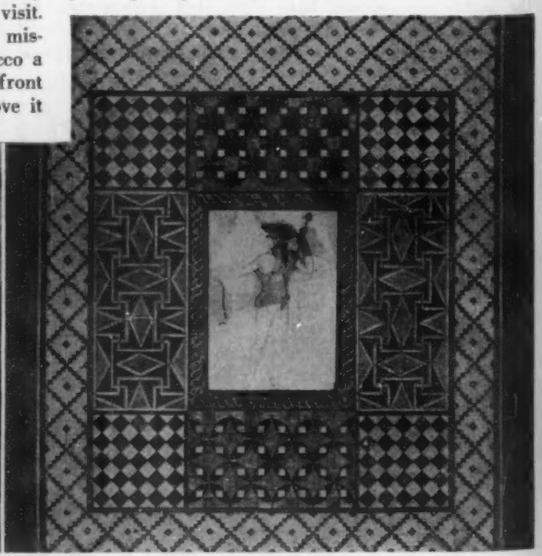
From water-colors by N. C. Shear

THE ATRIUM OF THE VILLA

The pool was open, the mosaic designs covered by a roof

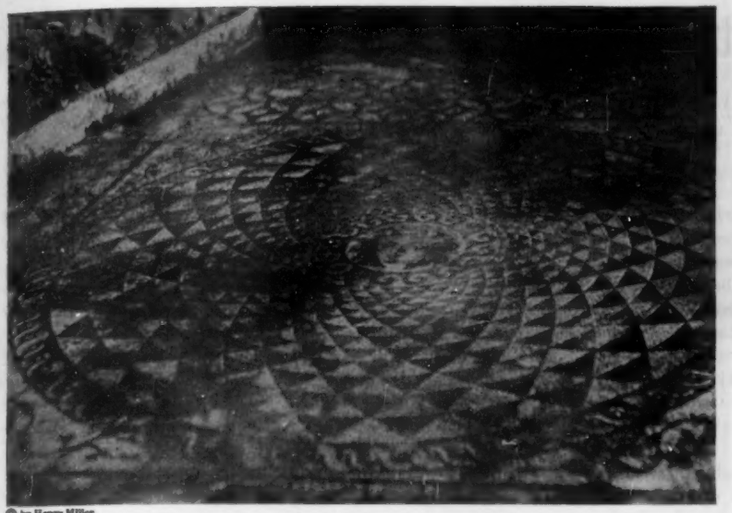
MOSAIC COPY OF A PAINTING

Panel from the atrium. Probably represents Paris



A FLOOR IN THE VILLA

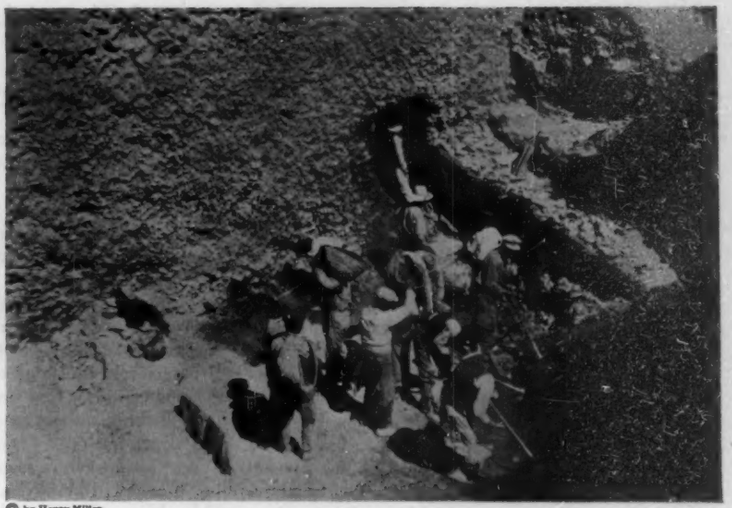
Figure of Bacchus with a thyrsus in his hand, set in frame



© by Henry Miller

THE ROOM WITH THE BACCHUS HEAD

The room is surrounded by a marble socle, above which the plastered walls are painted in a mottled pattern



© by Henry Miller

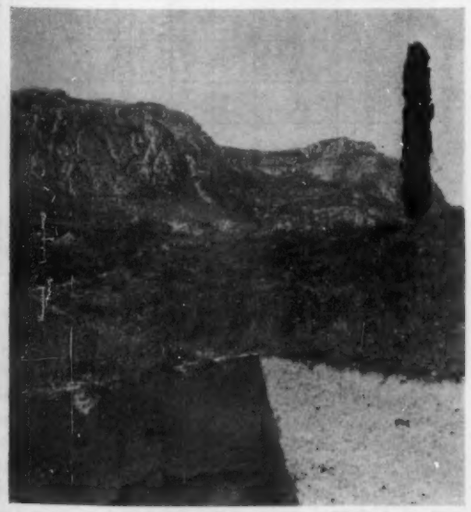
IN THE ORCHESTRA OF THE THEATRE

Clearing the wall on which gladiatorial contests are painted. This work is done by laborers under supervision

the bodies, the beautiful folds of the drapery, the life and vigor of the execution mark this as a masterpiece. In the same vicinity was found an exquisite archaic ivory of the 6th century B. C. This is a figure, something over three inches high, in the shape of an upright lion, which served as one of the supports of some dedication of value, perhaps a small gold or silver bowl. It is a well carved work, and the surface of the ivory is perfectly preserved. In addition to other small objects, such as lamps and coins, heavy foundation stones of the Greek period were here uncovered and some large roof-tiles.

While the main excavation was in progress, it became necessary to despatch several workmen to a spot about a mile west of the theatre beside the Sicyon road to clear and protect a bit of mosaic pavement that was in danger of being washed away by a rivulet from a fountain close by. This led to the discovery of a sumptuous Roman villa, of which five rooms were uncovered, all with mosaic floors of beautiful and intricate patterns.

The villa stands in a pleasant location, with the rich plain sloping in front towards the Corinthian Gulf, while in the distance behind rises the citadel of Acro-Corinth. It was supplied with excellent water from an abundant spring. At one end of the house the atrium, a large room 23½ feet square, has a square impluvium in its center, at each corner of which is a column base. The impluvium is a cement-lined pool, about a foot deep, that was open to the sky, while a roof, supported by the four columns, protected the rest of the room. On each side of the pool a picture is represented in mosaic, 3¾ by 3 feet, in size, which is surrounded by a frame consisting of a colored wave pattern within an elaborate meander design. The picture on the south side, which is perfectly preserved, shows a shepherd standing beneath an olive tree and playing a pipe, while to the right are three oxen, two standing and one lying down on the ground. There are remarkable attempts at foreshortening in the drawing of the cattle, and landscape is represented by a sloping hill in the background. As the youth wears a leopard's skin, this may be a picture of Paris portrayed as a shepherd on the slopes of Mt. Ida.



THE CITADEL OF CORINTH

The excavation in the auditorium of the theatre. In the background stands the Acro-Corinth

Head of Bacchus a Mosaic Gem

Opening from the southwest side of the atrium is a small room, 11 by 10½ feet, which has a mosaic gem on the floor. The centre of the design is an upright panel with a standing figure of Bacchus, who holds a thyrsus in his hand and has an ivy wreath in his hair. This panel is framed by the guilloche design that is used around all the pictures of the villa. The outside border about the room is a series of large black crosses, with four narrow red bands across each bar, set on a white ground. Then comes the rectangle of geometric decoration about the picture, with the colors all shifting in the repetition of the designs.

Northwest of the atrium, a doorway leads down to the large triclinium or dining-room, 23 feet square. In the center of this room is a panel picture of Europa on the bull, 4 feet square, framed by a series of decorative bands. Outside the picture frame, the entire floor is covered with a design of red and blue crescents with pointed projections in the center. The simplicity of this pattern is probably due to the fact that the floor was in large part concealed by dining couches placed about the room.

From the southwest corner of the triclinium, a doorway leads to a small room, 14½ by 11 feet in size, of which the mosaic floor is intact, and part of the frescoed wall is preserved to a height of one and a half feet. This room is the finest discovered in the villa, but the patterns are so complex that a brief description can give only an inadequate idea of the beauty of the designs. Bordered by decorative bands of intricate circular, crescent and diamond motifs is a square panel, about 7 feet square, in each corner of which a cantharus is represented with ivy or vines extending from it. Inscribed in this square is a circular frame of waved design, and within this are concentric circles of pyramids, variously colored, centering on a small inner circle, a little more than a foot in diameter, in which the head of Bacchus is portrayed.

Numerous objects of minor importance were found in this magnificent villa. The extreme range in date for the coins is from the 3rd century B. C. to the comparatively recent times of the Turkish occupation. There are vases of Roman date and potsherds of many types, some belonging even to the Proto-corinthian group. Among other finds worthy of mention are the stone spindle whorls, the ivory pins and the clay lamps. Three of the lamps are of a characteristic Corinthian shape with a square nozzle, and are made of the soft buff-colored Corinthian clay, which is covered by a white slip and is decorated with red bands. A lamp of this distinctive type was also found in a well in the Athena trench, where the stratification of successsive deposits is fairly reliable. Near it was a coin of Agrippina, Jr., who died in 59 A. D., so that this type of lamp may be reasonably dated in the middle of the first century A. D. At this time, Gallio was Roman proconsul in Corinth, and there, presiding over the tribunal he refused to hear the charges of the Jews against St. Paul. It is diverting to fancy that this villa may have been the suburban residence of the Roman governor of the province at that time.

A MONUMENT RESURRECTED

The painted wall was found buried beneath forty feet of earth. The colors were still bright and fresh

The Scientific Study of Athletics

Our Bodies Are Machines, Whose Energy Expenditures May Be Closely Measured

By A. V. Hill

Professor of Physiology, University College, London, England: Nobel Prizeman in Medicine

DURING severe prolonged effort an athlete's heart must be pumping out blood, to supply his muscles with the necessary oxygen, at a rate not less than 30 to 40 litres per minute—seven to nine gallons: and that against a pressure of about one-fifth of an atmosphere. As a matter of fact, the right and left chambers of the heart both expel the same amount, so that the total is really 14 to 18 gallons!

The pulse rate of an athlete, usually low at rest (50 per minute), is so responsive to the psychological effect of "go," and to the physiological stimulus of effort, that the very first beat after starting is measurably shorter than at rest, and the rate goes soaring up rapidly to 180 beats or more per minute, a level at which it may be maintained for considerable periods.

Lactic Acid and Fatigue

The long-distance runner may be breathing twice his own volume of air per minute. From this he may be taking into his blood some four litres of oxygen, about one gallon. This oxygen is utilized in the combustions which provide him with energy. Energy indeed is required: each member of the crew of an eight-oar boat may be developing 0.6 of a horsepower of actual mechanical work throughout a three-mile race: in a 100-yard sprint the muscular effort may be so intense that it would require an expenditure of total energy equivalent to about 15 horsepower to maintain it! In sprinting, lactic acid is being liberated in the muscles at the rate of four grams or more per second—an ounce in seven seconds: at the end of a 300-yard race there may be a quarter of a pound of this potent substance free in the tissues of the body, producing those very obvious symptoms which we call "fatigue."

The power expended in running increases about as the cube of the speed; that is why the highest

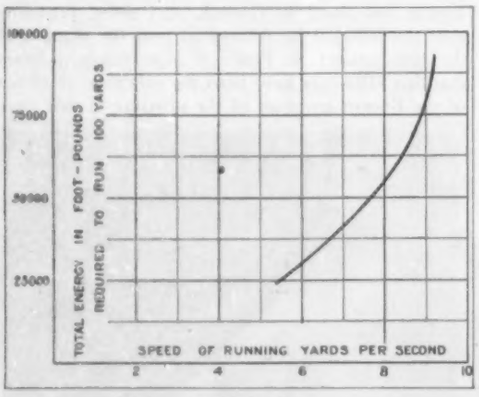


FIGURE 2

Total energy in foot-pounds required by the subject of Figure 1 to run 100 yards at various speeds

speeds of running are so extremely expensive and exhausting. In running fast a man is always working wastefully: he is getting a velocity up to 20 miles or more per hour, as it were, on low gear. With artificial aids—a bicycle or an oar—he works on a higher gear with a smaller number of "revs. per minute," and recent studies have shown that in rowing, the frequency of movement—30 to 40 strokes per minute—is approximately that at which the greatest mechanical efficiency is realized. The boat and the oar have been evolved by long experience, to allow the attainment of that optimum.

The magnitude of the bodily changes involved in severe exercise is such that it is difficult at first to appreciate their importance. Considerations of energy are of course not the only factors: athletics is not merely biochemistry: that is obvious. But it is obvious also that energetics and biochemistry present the framework on which all the other activities depend.

When a muscle is stimulated, a certain amount of lactic acid is liberated at certain surfaces within it. This, by some physical or chemical process still

FIGURE 1

The subject of the experiment, having run 120 yards, collecting his expired air in a bag

uncertain, causes a development of force and, if allowed, a shortening of the muscle. The acid is then rapidly neutralized, its effect passes off, and the muscle relaxes. The process can be repeated again and again until the available supply of alkali for neutralizing the acid has been used up, when the rapidly increasing acidity of the muscle stops its further activity. This stage is that of complete fatigue, and the amount of work which the muscle can perform depends on the degree to which it can tolerate acid before this stage is reached.

The acid, moreover, which accumulates has many effects before further activity has become impossible. It excites the "respiratory centre," a portion of the brain which controls the breathing; it regulates the amount of oxygen utilized by the body; it slows the relaxation of the muscle. This last effect is very striking in short distance races, where slower muscular relaxation, commencing within seven or eight seconds from the start, causes a progressive diminution in the maximum speed long before exhaustion.

This formation of lactic acid is the chemical reaction on which the whole of voluntary muscular activity depends. Just, however, as an electrical storage battery requires recharging after use, to restore its power of supplying current, so the muscle needs to be restored to its previous state; its lactic acid must be transformed back to its precursor, a process requiring a supply of energy. This energy comes from the combustion of foods by oxygen supplied through the lungs and circulation.

All the oxygen used by a man during and after muscular exertion is employed in this "recovery process." When the effort is very severe and of short duration the whole of the oxygen used may be consumed after the exercise is over. During long continued moderate exercise a balance may be attained between new formation of acid and restoration of that previously liberated.

The capacity of the body for long continued effort depends, among other things, upon the maximum available supply of oxygen, while the capacity of the body for short-lived, violent effort depends chiefly upon the maximum amount of acid which can be tolerated by the muscles. The amount of lactic acid present can be measured by the volume of oxygen required, in recovery, to effect its removal. This quantity has been called the "oxygen debt." The capacity of the body for exercise depends, therefore, (a) upon the maximum rate of oxygen intake during exertion, which is determined by the efficiency of heart and lungs, and (b) upon the maximum oxygen debt which the body can tolerate. These maxima are fairly well established for athletic men of average size, (a) is about four litres per minute, (b) is about 15 litres.

Results Are Beyond Dispute

The oxygen requirement of running at various speeds can easily be measured. The subject runs about 100 yards at any required speed, holding his breath the while, and at the end lies down at once upon the ground and allows all the air which he breathes out to be collected in a bag for a period of about half an hour. A measurement of the volume and an analysis of the contents of the bag give us then the oxygen used as the result of running 100 yards at that speed. A photograph of a subject and some of the apparatus is shown in Figure 1. The results obtained on him are given graphically in Figures 2 and 3. From the curves, and from other data known for this subject, a very interesting calculation can be made.

To make the matter clearer, quantities of oxygen

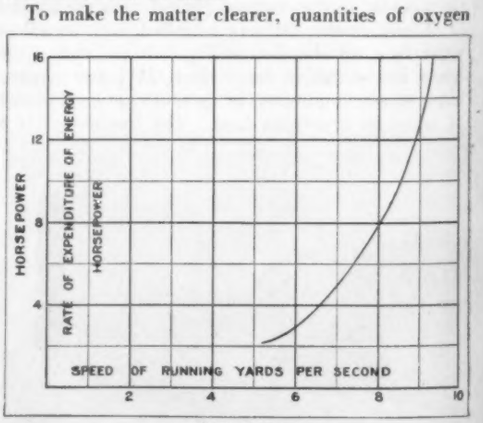


FIGURE 3

This chart shows the rate of expenditure of total energy, in horsepower, in running at various speeds

used may be expressed in terms of total energy set free. One litre of it corresponds to about 15,600 foot-pounds of energy liberated. In an uneconomical process such as running, a small fraction only of this energy appears as mechanical work; the rest is wasted as heat. Recent experiments on the subject of Figure 1 have shown that the relation between the total energy used in running 100 yards and the speed of running is that shown in Figure 2.

The amount of energy used at the higher speeds is astounding: 80,000 foot-pounds are required to run 100 yards in 11 seconds—enough (if employed with a mechanical efficiency of 25 percent) to raise the subject's body (about 140 pounds) 144 feet into the air. In spite, however, of their astonishing nature, there can be no doubt at all of the general truth of the facts shown graphically in Figure 2: the experimental results are clear and beyond dispute and emphasize the energetic nature of sprint running.

The matter can be expressed in another way. We may calculate the *rate* of expenditure of energy and express it in horsepower, or kilowatts. Again it must be emphasized that this horsepower—these kilowatts—do not represent actual mechanical *work done* but only the *total energy* available in the chemical processes resulting from the exercise. The chief part of this power is wasted in warming the body. The results are shown in Figure 3. These again are astounding: 13 horsepower is being exerted during the process of running 100 yards in 11 seconds: 16 horsepower in running it in 10⅘ seconds, which is the fastest we have recorded on our subject.

Timed Throughout a Run

Let us make a further calculation. When his oxygen intake has been raised to its maximum by severe exertion, he can consume about 3¾ litres per minute. This corresponds to a steady liberation of total energy at the rate of 1.77 horsepower. His maximum oxygen debt is 16.3 litres, which corresponds to 7.68 horsepower exerted for one minute, or 3.84 horsepower for two minutes, or 2.56 horsepower for three minutes, and so on. Thus, if he runs for a short time only, and expends all his "capital," he has available a far greater supply of power than if he has to run for a longer time and so to spread his "capital" over a longer interval. By proceeding in this way we may calculate that this particular subject can run various races in the following times:

Distance..	300 yds.	¼ mile	½ mile	½ mile	¾ mile	1 mile
Time calculated...	32.4″	52″	1′ 15″	2′ 4″	3′ 22″	4′ 44″
Time observed..	34″	51⅗″	1′ 15″	2′ 2″	....	4′ 40″

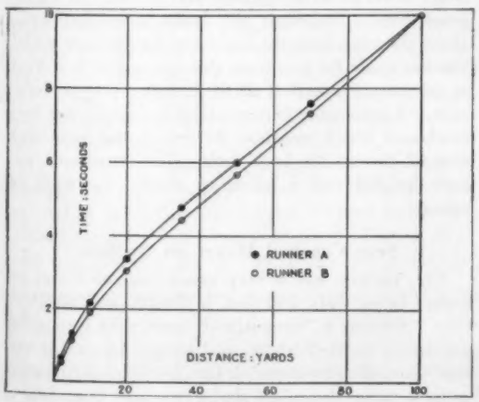


FIGURE 5

The relation between the time and the distance covered by two imaginary runners, A and B, dead-heating in 100 yards. Such observations can readily be made by the method described in this article

The last row of figures gives the actual best times he has recorded: there is no doubt of the striking general agreement between "calculated" and "observed." We are correct therefore in ascribing the variation of speed with distance mainly to factors of energy and oxygen.

In organizing a sports meeting one of the problems is to allow sufficient intervals between heats and finals, and between different races in which the same runner may be performing. Recent studies of the rate at which the recovery process after exhausting exercise occurs in normal healthy men have shown that recovery is not quite complete until some 60 or 70 minutes have passed. In general, the more exhausting the exercise, the longer will be the recovery.

It is clear, however, from the curve of Figure 4 that the major portion of the recovery process, even after exhausting exercise, is completed within a comparatively short time. Five minutes after such exercise the recovery has proceeded to 46 percent completion: ten minutes after to 64 percent: twenty minutes after to 80 percent. Obviously, therefore, in short distance races by trained men, no great harm is done by allowing heats to occur within twenty minutes or so of one another. In order, however, to attain the absolute maximum of performance it would seem advisable to allow at least three quarters of an hour (95 percent recovery) between semi-finals and finals.

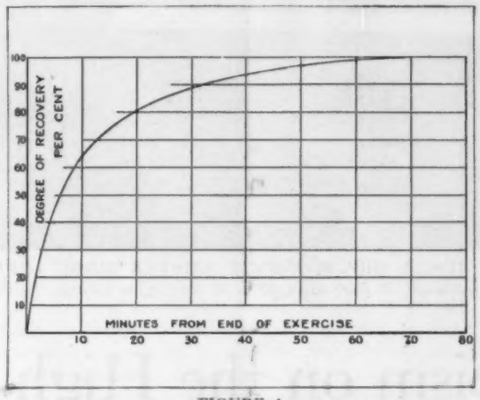


FIGURE 4

The course and duration of the recovery process after severe exercise lasting for several minutes: the recovery is measured by the amount of oxygen used in it, the total amount being called 100

It has long been obvious that electrical methods would be far more accurate than those usually employed for timing races. Their apparent complexity and expense, however, together with the conservatism of governing bodies, have prevented their adoption hitherto. Moreover, if only the *total* time in a race is to be taken, the information obtainable seems scarcely of sufficient interest, either to athletes or to scientists.

It is entirely a different matter, however, if times can be taken with accuracy at intervals *throughout a single run.* Let us imagine, for example, that the moment at which the pistol is fired and that at which a runner completes 2, 5, 10, 20, 35, 50, 70 and 100 yards can be recorded, in each case accurately to 0.002 sec. Such times for two imaginary athletes A and B, are recorded graphically in Figure 5. Clearly by such methods all kinds of questions can be answered. The lag of taking off, the initial acceleration, the maximum speed, the rate at which the velocity decreases later, the onset of fatigue, can all be ascertained. From Figure 5 we can further construct Figure 6, showing the velocity of our two imaginary runners throughout their race. They finish with a dead heat; A has started much more slowly than B; he attains, however, finally a greater velocity than B which also he is able to maintain, while B's velocity begins rapidly to diminish.

For actual runners, no doubt, the curves would be different from those shown in these figures. In general, however, such curves and such differences would appear, and it is obvious that the record is a characteristic for any particular individual.

Are such accurate measurements possible? Indeed they are, and by comparatively simple methods. Figure 7 shows a photographic record, made on a string galvanometer, of the moments at which a small magnet held in a man's hand was passed rapidly to and fro through the middle of a large coil of wire, wound round a frame 7½ feet high and 4½ feet wide, standing vertically in a passage in the laboratory. Such a coil can equally well be mounted in a field and connected to a galvanometer located in the pavilion.

FIGURE 7

Records made on a string galvanometer of the moments at which a small magnet passed through a large coil of wire. When such a coil is erected over a track and the magnet carried by the runner, the times of passing through all the coils may be recorded accurately

Two Runners Timed Together

Similar records can be made by attaching a small magnet to a cap worn on the head, or by sewing a thin magnetised wire, six to nine inches long, on a man's clothing. Eight such coils, arranged in series along an experimental running track, would give eight such records on the photographic paper, the intervals between them being measured by comparison with the cross lines of an accurate time-marker. The moment at which the center of the magnet passes through the coil can be read to 0.002 sec. from the point A at which the record crosses the base line. There is nothing to impede the runners, the track is clear, the coil is merely an archway over it, the pistol can be recorded by a microphone coupled with the coils. There are no wires to break, the magnet need weigh only an ounce or two, the pistol is fired, the run is completed, the photograph is taken, and within five minutes or so the record can be developed, worked out, and, if desired, plotted in a curve like that of Figure 5.

The expense of such a permanent installation would be only 1,000 to 1,500 dollars. Its use need not be limited to short races: a quarter-mile track could easily have eight or ten such coils erected along it, so that all races could be timed and recorded with the same degree of accuracy. Two runners could be timed together throughout a race, by the simple device of arranging their magnets in opposite directions, so that their records, also in opposite directions, could be distinguished from one another.

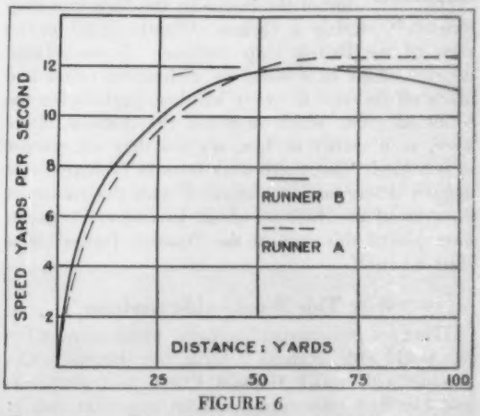
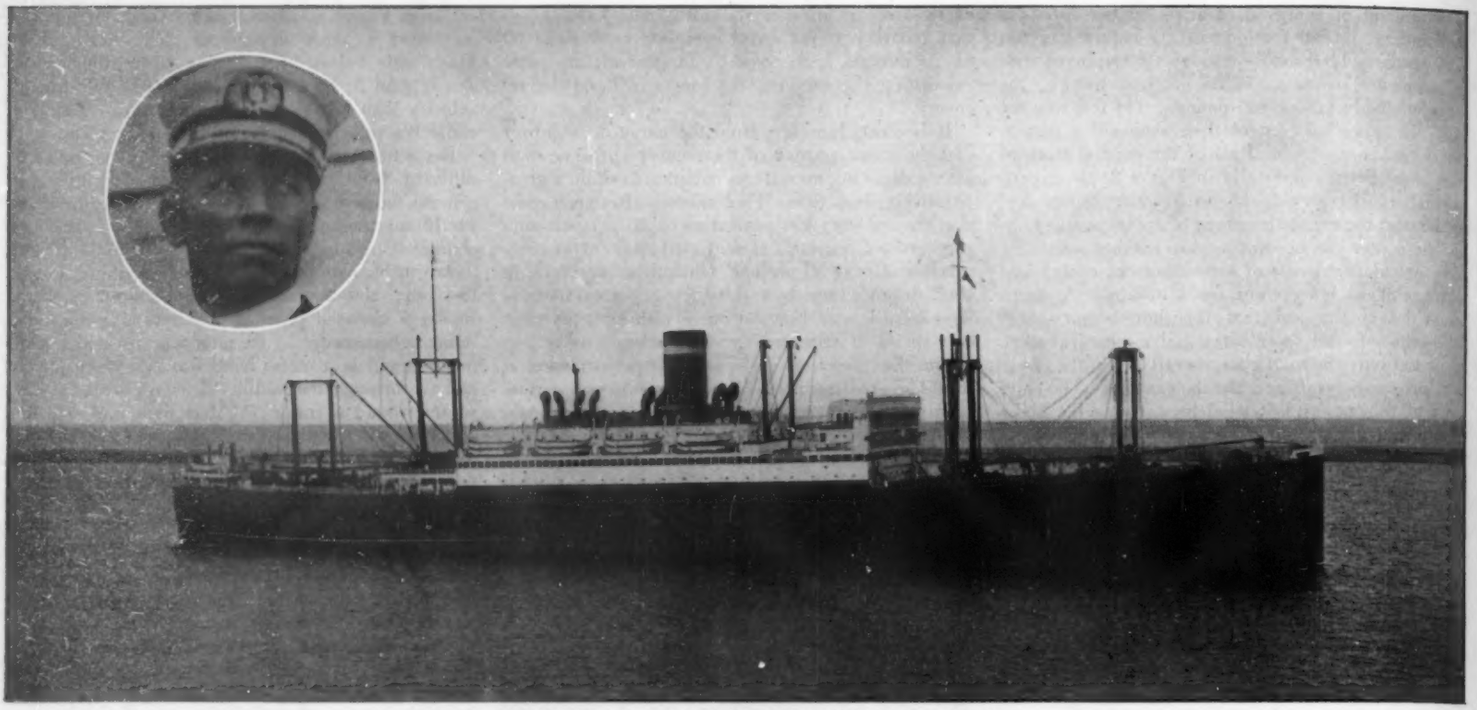


FIGURE 6

Deduced from Figure 5. Speed at various points during a 100-yard race of two imaginary runners, A and B. A starts slower than B, but attains a higher maximum speed and maintains it longer

Such an installation would prove a most valuable tool in the scientific study of athletics.



THE RESCUE SHIP, *ROOSEVELT*, AND HER HEROIC CAPTAIN

Length, 516½ feet; breadth, 72½ feet; freeboard, 32 feet; draft, 27 to 30 feet; gross tonnage, 14,187 tons; maximum sea speed, 20.04 knots

Heroism on the High Seas

An Epic of the Daring, Skill, and Self-sacrifice of American Sailormen

By J. Bernard Walker

SEARCH the long records of the world's merchant marine and you will find no story of the saving of life that has made a wider appeal to the world than that of the rescue by the American ship *Roosevelt*, during a furious Atlantic gale, of the crew of the British ship *Antinoe*. Times without number, ships have stood by a disabled vessel and taken off its crew in heavy weather; and during the series of gales which overtook the *Antinoe*, there were, as a matter of fact, no less than six rescues of this kind. But, there were features of daring and dogged determination connected with the rescue of the crew of the *Antinoe*, which, by common consent, have placed this epic of the "roaring forties" in a class by itself.

Why This World-wide Acclaim

There are two outstanding facts, which account for the world-wide acclaim. First, the dogged perseverance with which Captain Fried, in raging seas and blinding snowstorms, and at imminent risk at times to his own ship, clung to the disabled vessel for four days on end. He lost her and found her again, and after trying every possible plan of rescue, and losing two men and six of his boats, finally transferred every one of the shipwrecked crew aboard his own ship. The other outstanding fact is that, undaunted by the loss of two heroic members of the crew of the *Roosevelt* in the first attempt at rescue, more than sufficient volunteers were found to man the boats under First Officer Miller, and make the final trips which were successful in bringing off the twenty-five men aboard the wreck.

It is not the purpose of the present article to tell in detail the story of this amazing rescue. That has been done so fully as to call for no repetition here. The present story is an attempt to bring home to those who have never witnessed an Atlantic gale in its full fury, a sense of the tremendous difficulty and fearful risks of the task which the rescuing ship so cheerfully undertook, and with such fearless heroism successfully accomplished.

The *Roosevelt* is one of a very successful class of sixteen ships, which was built during and subsequent to the great war. They are fine, seaworthy boats of unusually high freeboard, and with a lofty superstructure occupying the middle third of the ship, devoted to passenger accommodations. The *Roosevelt* is 516½ feet long; 72½ feet broad and 28 feet deep. She carries 436 passengers and a crew of 223, stows a cargo of 5,000 tons and is rated at 14,187 gross tons. Although she looks somewhat bulky above the waterline, she has a fine underwater model. She has made the trip from Queenstown to New York at an average speed of 20.04 knots—a fine performance. A noticeable feature about the ship is her high freeboard which measures 32 feet to the main deck and 62 feet to the boat deck. This freeboard was both helpful and a handicap during the work of rescue.

THE DISABLED *ANTINOE*

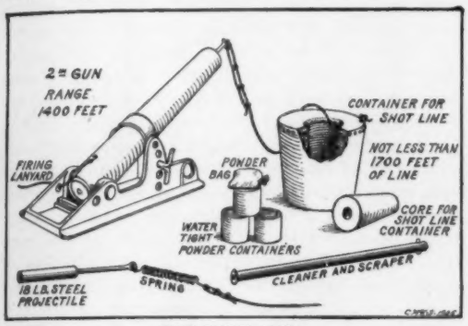
This little ship, 2,079 tons, is sinking. The boats are gone, hatches stove-in, stearing gear disabled and fires out

Seas Crashed Down on *Antinoe*

The *Antinoe* was a very small boat as things go today, being only 280 feet in length and of 2,079 tons. She was a "three-island" boat, with forecastle, amidships superstructure, and poop. Loaded as she was when disaster overtook her, her freeboard in the wells between the raised decks can have been only a few feet. So long as nothing gives way, such a ship can make fairly good weather in an Atlantic gale when riding head to the seas. But the steering gear broke, the little ship swung off into the trough of the seas, the giant combers came crashing aboard, hundreds of tons of water at a time, splintering her wooden hatches, filling the engine and boiler rooms, and putting out the fires. She was in this condition when her cry for help came over the waters and was heard by the wireless operator aboard the *Roosevelt*.

When the message was received, both ships were probably out of their estimated positions, for both of them had been running by dead reckoning. The *Antinoe* was 100 miles out. It was due to that marvelous instrument—the radio compass—that Captain

Fried was able to find the ship in all that fury of wind, sea and driving snowstorms. He reports that he found the ship in a bad way and that in answer to his signal "Do you wish to abandon," they replied, "Not yet, thank you, wish to try making repairs and secure hatches. Please stand by." When later they asked to be taken off, the boats were gone, eight feet of water was in engine and fire rooms, and with a list of 40 degrees, the lee rail was under water. Her condition is shown in the accompanying photograph taken from the *Roosevelt*. The wireless was gone and communication was made by signal flags in the day time and by a dollar flashlight at night.



THE LYLE GUN

The 18-pound projectile, attached to 1,700 feet of light line, has an extreme range of 1,400 feet. The gun is fired with smokeless powder. To the left is a shot with coil spring, designed by Colonel Hearn

The *Roosevelt* herself was rolling 30 degrees and taking green seas aboard, and Captain Fried reports "there was also the danger of running into the *Antinoe* because we could not see very far." As night came down, they lost sight of the wreck and for nineteen hours the *Roosevelt* kept up the search, picking up the ship again at 3:40 P.M. the next day.

It should be stated that on first finding the ship Sunday evening, the *Roosevelt* placed herself to windward and discharged oil overboard to smooth down, as far as could be, the breaking seas. This discharge of oil was made when she found the ship again, and at once a boat was lowered. A sudden squall swept round the bow, a steep sea threw the men out of the boat, and it was with great difficulty that six of them were rescued. In spite of every effort, however, two gallant fellows, Master-at-Arms Witanen and Boatswain's Mate Heitman were swept away and drowned.

The *Roosevelt* continued pumping oil overboard through the night, and at noon the next day, attempted to get a line aboard the *Antinoe* by means of the Lyle gun. Ten shots were fired. Then a lifeboat was lowered and drifted under the *Antinoe's* stern, but her crew could not hold her. On the morning of Wednesday, rescue work commenced again. Three attempts were made to lay a lifeboat alongside the wreck, and finally a line was shot across the *Antinoe*, and a lifeboat was made fast to a stronger line which had been hauled aboard the wreck; but the line parted and the boat was lost. An attempt was made to get a line to the *Antinoe* by floating it across the seas attached to a cask; but the line sagged and the cask was unable to carry it to the ship.

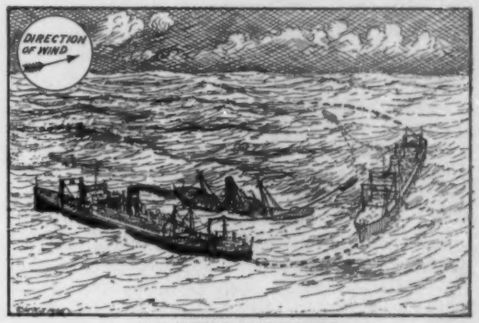
Captain Fried then tried the daring maneuver shown in one of our drawings. He steamed to leeward of the wreck, put overboard a lifeboat, and made fast the inboard end of the rope to the top of an after-kingpost at an elevation of 75 feet above the sea. He then steamed past the stern of the *Antinoe* and swung sharply around to weather of her, hoping thereby to draw the tow rope over her stern, but the rope sagged in the water and passed under instead of above the wreck.

Carrying Lines to *Antinoe*

The Lyle gun, as shown in one of our illustrations, is the standard type used by lifeboat service in rescuing stranded ships by means of the "breeches buoy." The gun has a bore of about two inches. The shot is about 18 inches in length with a steel rod of about the same length projecting from one end. To the rod is attached a light, cotton line. The line, about 7,500 feet in length, is coiled inside a tub-shaped container. After the shot leaves the gun, the drag of the line causes the shot to reverse itself, so that it travels through the air with the shot first and the rod and its attached line trailing after. A ship ordinarily carries from three to five of these lines. After these had been shot away, Captain Fried had to use any small line that he happened to have aboard, and the sudden pull on the lines caused them to break. Colonel Hearn of the Army, who was a passenger, suggested placing a coil spring between the projectiles and the line, so as to absorb some of the initial energy and start the line more gradually. This proved to be successful.

The upper right-hand picture shows the daring maneuver by which Captain Fried attempted to carry a line across the stern of the *Antinoe*. The lower left-hand cut shows the shooting of a line, an attempt to drag a lifeboat from the *Roosevelt* to the *Antinoe*, and the attempt to float a line down to her by means of a cask.

Now, just here we wish to emphasize the great risks which Captain Fried did not hesitate to undertake in his dogged determination to save the shipwrecked crew. In the first place, it must be remembered that a gale of terrific force was blowing, and that seas, at 30 to 40 feet high, were running. Engineers on shore in designing big bridges and tall buildings, use a unit pressure of 30 pounds per square foot in estimating the total maximum wind pressure for which they must make provision in designing their structures. Now, the *Roosevelt* in placing herself broadside to the seas and to windward of the *Antinoe*, presented a total area of about 22,000 square feet of surface to the wind, and a simple calculation shows that she was, therefore, pushed to leeward with a pressure of 300 tons or more on her hull structure alone. To oppose this was her submerged hull with a draught of 27 to 30 feet. The little *Antinoe*, with her main deck flush

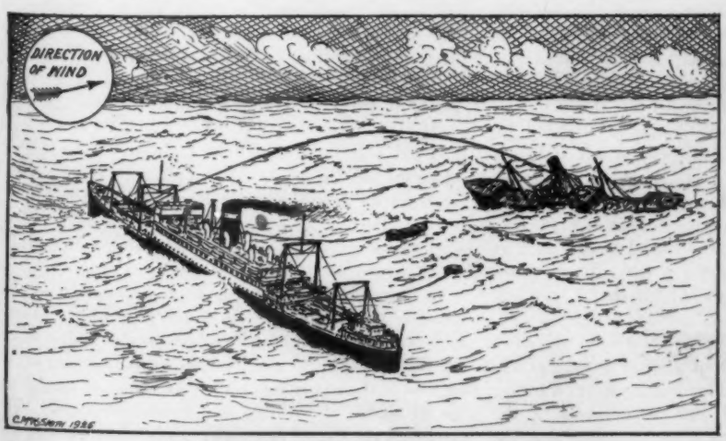


A DARING MANEUVER

The Roosevelt, *towing a lifeboat from lofty kingpost on the quarterdeck, crosses the stern of the* Antinoe, *swings sharply around and takes up a position to windward, trying to carry line over wreck*

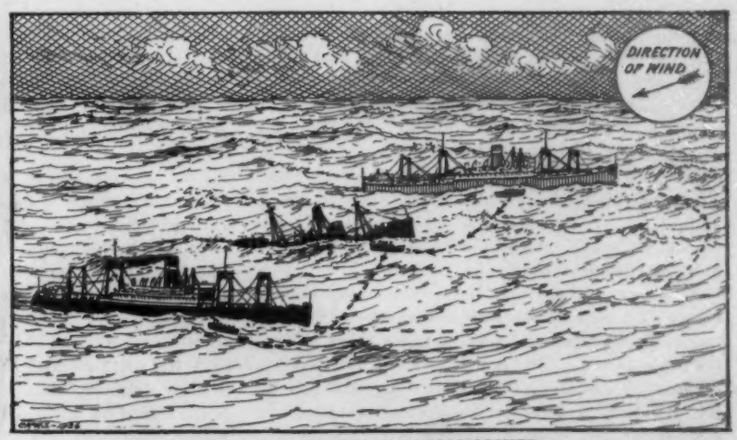
with the water, was drawing probably as much water as the bigger ship, and since her area above water was very limited, she was probably making only about one-third of the leeway of the *Roosevelt*. Nevertheless, Captain Fried did not hesitate to place himself within a few hundred feet of the wreck. Had his engines broken down, or if he carried insufficient way upon his ship, he would have been in imminent danger of drifting too close and of being lifted on one of the enormous seas and dropped upon the *Antinoe*. That would have meant the loss of every soul on both ships.

In considering the two final and successful attempts, we must remember that a lifeboat in such weather can make progress only down the wind. Hence the *Roosevelt* was placed to weather of the *Antinoe* and the boat was lowered from the leeward side. First Officer Miller brought it under the lee bow of the *Antinoe* and took off the men. Meanwhile, the *Roosevelt* steamed to leeward of the wreck, and the lifeboat, still pulling down the wind, fetched up to leeward of the *Roosevelt* and transferred the rescuers and rescued to that ship. Twice was this maneuver carried through—the second time by moonlight.



ATTEMPTS TO GET BOAT TO THE *ANTINOE*

Various attempts were made to rescue the crew. Sixteen lines were thrown with the gun. Boats were floated or drawn over. A line was floated down by a cask



THE FINAL RECUE IS ACCOMPLISHED

The Roosevelt *steams to windward; her boat pulls under lee bow of wreck; the* Roosevelt *steams to leeward of the* Antinoe, *where she recovers the men from the boat*

Our Point of View

Wasting Our Patrimony

IN the present issue we commence a series of articles designed to show with what extravagance we have wasted our national patrimony as represented by the rich natural resources with which Nature has endowed the territory of the United States. The wealth and general prosperity of the country are largely due, of course, to the intelligence and energy of its people; but it can hardly be disputed that it is equally due to the natural wealth of the country.

It seems as if Nature must have said, I will prepare a land, which, in respect to the necessities of life and the conditions for the upbuilding of a highly civilized people, shall be absolutely self-contained. I will cover its surface with the richest of soils, watered by majestic rivers and clothed, in great part, by forests, which in the variety and magnificence of their timber, shall be unapproached elsewhere on the planet. Underneath the surface, I will lay up practically inexhaustible stores of fuel, both coal and oil. And in readiness for the great industrial age, which will come in due course, I will enrich this favored land with vast accumulations of metalliferous rocks so readily accessible that, in the case of iron, the ores can be shoveled up by the millions of tons and drawn away in train loads to the smelting furnaces.

It is a priceless patrimony; but, alas, with all the extravagance of the thoughtless youth who comes suddenly into a vast fortune, we have expended our riches as though they were absolutely without limit —which they are not. It is only of late years that we have been moving to a full realization of our youthful extravagance. We have learned these facts a little late, but not too late. It remains for us to put into practice those principles of thrift and conservation, which have long been practiced by the older civilizations of Europe.

This series of articles, of which the first appears in this issue, will constitute an extensive survey of our natural resources, showing what we have spent of our patrimony, how much of it remains, and how we can best conserve the remainder and prolong to a far-distant day the date of its exhaustion.

Burn Your Smoke

NOT many years ago, the atmosphere of the city of Pittsburgh was so thick with smoke that, to any visitor from an anthracite-burning city, the place was a horror. Your snow-white collar of the morning was an unholy smudge by noon, and your immaculate cuffs would cause a tramp to look upon them with a dubious eye. Milady's dainty fabrics were quickly soiled by the universal soot, and no matter how fair the outside of your office building or your picturesque home, its freshness and charm, both inside and out, vanished, only too soon, under the intimate caresses of the smoke-charged atmosphere. Today, Pittsburgh is a clean city and gets its full share of sunlight and unadulterated breezes; for it has learned to burn its smoke.

Some thirty years ago, the writer found himself on the footplate of the engine that hauled the fast train carrying the transatlantic mails from Queenstown to Dublin. He noted that the engineer, in addition to keeping a lookout for signals, had his left hand on a lever which opened and shut the laterally sliding doors of the fire box. As the fireman swung a shovelful of coal toward the furnace, the engineer would snap the doors open, and then close them very gradually with a slow movement of the lever. We asked him why he shut the firedoors in such leisurely fashion. "I am burning the smoke, sir," he answered, "watch the smokestack." We had already noted that there was a complete absence of smoke. Immediately after the next shovelful was thrown in, he closed the door with a sharp snap and at once a dense volume of black smoke poured forth. He told us that he and the fireman were paid a certain sum for every ton of coal that they saved below a definite fixed amount which was allowed them for the round trip, and that careful firing meant a considerable addition to the pay envelope.

The recent coal strike was rapidly shrouding many of the cities of the United States with a pall of smoke which threatened to reproduce the unbearable conditions that prevailed in Pittsburgh before that city had learned to consume the smoke of its fires and furnaces; and though the strike is over, a wise public will not soon forget the warning. With the passing of the weeks, the conditions were becoming increasingly serious. Buildings were discolored; wearing apparel and fabrics in the home ruined, and the health of the inhabitants—so the Boards of Health had told us—was being seriously jeopardized. Now all damage and discomfort of this kind is easily preventable. Most of it can be avoided by admitting above the bed of glowing coals sufficient air to provide the oxygen for burning the gases before they escape to the chimney or smokestack. A little patience on the part of the citizen in his home, or of the fireman in the factory will enable him at once to burn the smoke and get the full, or practically full, heating value out of his coal.

Brotherhood of the Sea

It is an age-long tradition of the sea that, although the sailorman outwardly may be brusque, more often than not he hides within him the gentleness of a woman and the heart of a lion. There is something in the sea that softens and broadens a man, and breaks up the shell of selfishness with which he becomes so sadly encrusted on shore. Never is this emancipation so strikingly manifest as when the cry for help comes over the waters. Then it is that the sailorman—be he captain or common seaman—will rise unconsciously to the heights of great heroism. In that hour, all the barrier walls of race, creed and social distinction fall down and man is seen standing in all his naked, God-imaged splendor. The four-day fight of the captain and crew of the *Roosevelt* to save the crew of the *Antinoe* (to say nothing of the many other glorious rescues of the recent storms) is a saga of the brotherhood of the sea that will be sung, and sung again, by the generations to come.

Is the Skyscraper Safe?

A WELL-KNOWN architect in a letter to one of the leading "dailies," has sounded a note of warning with regard to the safety and permanence of the modern so-called skyscraper. He suggests that the steel structure, which is hidden from sight by its covering of cement or tiling, or both, may be subject to oxidation on its surface or molecular changes within, which, in the course of time, may bring about its collapse. As a precaution, he suggests that from time to time the covering of the steel should here and there be removed sufficiently for inspection.

As a result of certain reassuring facts which have been well-established by investigation and experience, we think that such a warning as this is not only unjustified but most unfortunate; since it may shake the confidence of the public in a form of construction in which, as a matter of fact, they have every reason for the fullest confidence. In the first place, on the tearing down, to make way for larger structures, of several skeleton-steel buildings that were erected many decades ago, it was revealed that the steel was in perfect condition in every case where it had been carefully covered in at the time of erection. It is a simple matter—a mere question of careful oversight by the foreman and the architect, so thoroughly to protect the steel against moisture that any future oxidation of the metal is out of the question. Where this has been done, the life of the steel frame may well run into the thousands of years; for the risk of the steel failing through molecular changes, or through "fatigue," simply does not exist. If the stresses in the framework were dynamic (as in the case of earthquake shock), and were continually recurring, there might be some point to this warning; but the stresses are static, except for some variation of load under wind pressure, and the steel can carry these stresses indefinitely. Good design and careful inspection should render a tall office building as lasting as the pyramids themselves.

Better Tools—Better Men

THE present widespread discussion of the handicaps and hardships of farm life is liable to overlook certain important facts of the problem. It is undeniable that, judged from the standpoint of the city dweller, the day-by-day life of the farmer is monotonous and hard; although, to tell the truth, it has no such monotony and is not nearly so hard as it was two or three decades ago. The automobile, the telephone and radio have gone far to banish loneliness and ennui from the farmer's life. Nevertheless, it cannot be denied that much of his daily labor is over hard and woefully monotonous.

There is, however, a remedy at hand, if the farmer will but use it; for just as electricity, through the telephone and the radio, has brightened his home life, so the same agent can take much of the hardship out of his work in the field, in the barn and in the woodshed. Furthermore, what electricity can do for the farmer, it can do also for his wife. The domestic drudgery that falls to the lot of the wife on the farm is proverbial; but for her, as for her husband and sons in the field, there is promise of emancipation in those many efficient labor-saving appliances—the electrically-driven washing machine, sewing machine, cleaner, and churn—which applied science has brought within reach, and will supply when the rural population demands them.

Although the drift of the farm population to the cities is due largely to the desire for the comforts and recreations from which the farm family is so largely shut out, it cannot be denied that the stronger motive is the above-mentioned growing antipathy to the drudgery of farm work. Hence, we repeat that the extensive use of electricity on the farm would go a long way, in stabilizing and rendering content our rural population.

A Stellar System 700,000 Light-Years Away

How the Distance to N.G.C. 6822, Containing Millions of Suns, Was Measured

By Henry Norris Russell, Ph.D.
Professor of Astronomy at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

AT various times we have had occasion to speak of the remarkable advances which have been made in recent years in sounding the depths of space. Another notable example of such work deserves our present attention.

In the constellation Sagittarius, in 19 h 41 m right ascension and 15 degrees south declination, the late Professor Barnard in 1884 discovered a faint diffuse nebula which later received the number 6822 in Draper's "New General Catalogue" of nebulae, and is therefore commonly known as N. G. C. 6822.

This object is so faint and extends so far over the sky that as a whole it can be seen better with a small telescope than with a large one. The small instrument with its wide field of view brings out the contrast between the faint luminosity and the darker sky surrounding it. The small field of a larger telescope falls entirely within the luminous area, so that there is nothing for the observer to notice. With a very large instrument, certain finer details—too small to be seen with one of moderate size—become visible. Between the small and very large telescopes there is a "blind zone" of instruments with which neither the object as a whole nor its detail can be seen.

The "Blink-comparator"

The real nature and remarkable character of the object was first revealed by photographs made by Duncan at Mt. Wilson in 1921 and by Perrine at Cordoba, Argentina, in 1922. These plates, made with powerful instruments, revealed it as a cluster, a "cloud" of vast numbers of exceedingly faint stars, accompanied by patches of thin nebulosity—the whole view resembling a miniature of the Magellanic Cloud.

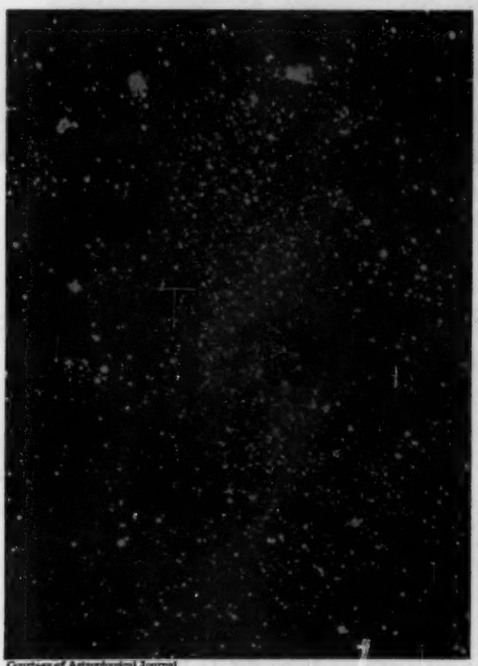
The small size of the star-cloud, only about 20′ by 10′, with a central core 8′ by 3′—and the extreme faintness of the individual stars, suggested at once that the system was very remote. A careful study was therefore commenced by Hubble, whose detailed discussion—just published—forms the basis of the present article.

The brightest stars of the cloud appear to be of about the 16th magnitude (photographically). Visually, they are probably of somewhat brighter than the 15th magnitude since, like the brightest stars in the star-cluster, they are red. The few scattered stars in the field, which are brighter than this are no more numerous than might be expected in any neighboring part of the sky, and are doubtless "foreground" stars, far nearer than the rest.

Down to magnitude 19.4—which is as far as good measures of brightness could be made—there appear to be about 750 stars in the cloud. The numbers increase very rapidly as the stars grow fainter, and there must be thousands of still fainter stars visible on long-exposure photographs with the great reflectors, although too faint to measure accurately.

More than fifty photographs of the cloud have been made with the great telescopes—the large number being necessary in order to search for and to study variable stars. Fifteen of them have been found within the cluster and more outside it—so that they must really be members of the group.

To discover one star of variable brightness among hundreds which do not change would be like looking for the proverbial "needle in a haystack" if it were not for the aid of the "blink-comparator." This very ingenious instrument consists of a pair of low-power microscopes set a couple of feet apart, with optical devices to bring the images from both to a single eyepiece. Two plates are placed in cameras, one under each microscope, and may be shifted by suitable slow motions until the images of the stars on the two plates, seen through the two optical systems, come into coincidence. A little lever enables the observer, by turning a small mirror, to see first one and then the other of the two plates.



Courtesy of Astrophysical Journal

N. G. C. 6822

Photographed by the 100-inch reflecting telescope at Mt. Wilson Observatory. Three and one-half hours' exposure

If the adjustments are correct, the change through substituting the star-images on one plate for those on the other, will cause no shift in their apparent positions. Every star, however, which has moved or has changed in brightness between the dates of the two exposures, will appear to "blink"—shifting in position, or changing in size in a remarkably conspicuous manner.

This makes the discovery of variable stars relatively easy—although, even so, the amount of work involved in taking dozens of plates with long exposures, and going over them, star by star, under the blink-microscope is by no means small.

When variable stars had been discovered, the work had only begun.

A standard scale of stellar magnitudes must be determined—by comparison with the "selected Areas" in which the brightness of the stars has been carefully measured—which required about a dozen special plates with double exposures, showing both fields on the same plate.

Then the magnitudes of the individual variable stars on each plate were measured. It appeared that the large majority of them—eleven, at least, out of the fifteen—showed regular periodic changes in brightness of the familiar Cepheid type with continuous variation, a rapid rise and a slow fall, with a range not exceeding one magnitude.

The periods of variation range from 64 days to 12 days. The magnitude at maximum ranges from 17.5 to 19.1 and—as is the case in other clusters—the stars with the longest periods are the brightest.

The relation between brightness and period is almost exactly the same as that which has been found by Shapley for Cepheid variables in other regions; but, for the same period, the stars in N. G. C. 6822 are apparently very much fainter. There can be no doubt of the meaning of this—the system is farther away. In fact, the variables are all about 21.6 magnitudes fainter than similar variables would be if placed at the standard distance of ten parsecs (or 32.6 light-years). From this it follows that the distance of the star-cloud has the enormous value of 214,000 parsecs, or 700,000 light-years.

The mere hope of measuring so vast a distance would have appeared wholly chimerical a couple of decades ago; but the evidence upon which our present methods are based is so strong that there can be no doubt of the substantial trustworthiness of the results.

Millions of Stars

More accurate measures (particularly of the real brightness of those Cepheid variables which lie relatively near the sun) may alter our compiled distances by twenty percent, or perhaps a little more; but the general character of the figures is not at all likely to be altered.

With this distance, it follows that N. G. C. 6822 is about 1,200 parsecs long by about half as wide—that is, it occupies a space great enough to include at most all but the very remotest of the stars visible to the naked eye, but small compared with the dimensions of the Milky Way. The denser central portion is about 500 by 200 parsecs.

The brightest stars in the cloud are about thirty thousand times as luminous as the sun, and therefore comparable with the brightest objects known in other star-clouds and among Galactic stars near the sun.

The total light of the system corresponds to the absolute magnitude—12.7—that is, to about twenty million times the light of the sun; and the total number of stars—most of them far too faint to be photographed—must run well into the millions.

Some of the small nebulae which can be seen and photographed here and there within the star-cloud have gaseous spectra and doubtless belong to the cloud. Their actual dimensions must be very great—averaging 120 light-years in diameter—but not greater than those of some of the nebulae in the Magellanic Clouds.

Most impressive of all to the imagination is the fact that there are a good many other "irregular nebulae" outside the Milky Way, which look very much as N. G. C. 6822 would do if removed to a still greater distance. Dr. Hubble says expressly that this object of his studies may be regarded either as the remotest star-cloud so far known or as the nearest of the irregular non-Galactic nebulae.

Distances up to at least three or four times that of N. G. C. 6822 can be measured by the present methods, and it is probable that more of these great star-clouds will, before long, yield up their secrets.

Photograph by Jannett Spencer, Courtesy of "American Forests and Forest Life"

A PATHETIC WITNESS TO THE APPALLING DESTRUCTION WROUGHT BY FOREST FIRES

Uncle Sam, Spendthrift—I

The Magnificent Forests Which Once Covered the Greater Part of the United States Have Largely Been Swept Out of Existence

By J. Bernard Walker

WHEN the Pilgrim Fathers first looked with eager eyes upon the coastline of the New World, they noted that it was heavily forested down to the very water's edge. The Dutch traders at Manhattan and the first colonists that sailed up the James River gazed upon virgin forests that extended unbroken, as far as the eye could see. And the early explorers who sailed their picturesque craft up and down the coast of the new wonderland noted that these forests extended, practically without a break, from Florida to Maine. Little, however, did they dream that this line of timber was but the fringe of a mighty forest that reached inland, in an unbroken sweep, for over 1,500 miles. We know today (see map on page 231) that the eastern half of the new continent was then clothed with over 680,000,000 acres of forest growth, in which was to be found, in great variety, those species of woods which man has found most useful, if not indispensable, for his daily activities and well-being.

Similarly, the first adventurous voyagers who skirted the western coasts of the American continent found that, for over 1,000 miles, there was a growth of softwood timber which, in the size and quality of its trees, was unmatched elsewhere in the world.

Courtesy of "American Forests and Forest Life"

THE LORDLY REDWOODS

"Only God can make a tree!" It took thousands of years to make the giant trees of the west

A "Gold Mine" of Untold Wealth

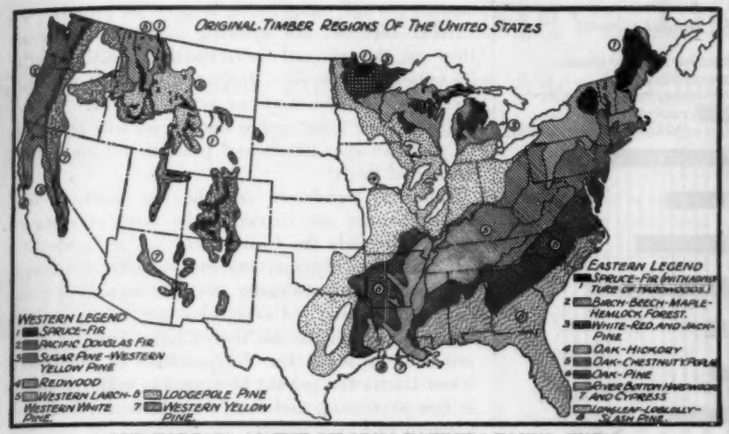
The earliest voyagers came in quest of a sea passage to the Indies with their fabled wealth of gold. Though they knew it not at the time, they had found gold, not, it is true, in the form of the glittering nugget, but in these stupendous forests of the New World. For here was "a gold mine" indeed, whose riches were to make possible the early development of a mighty people who, within a brief stretch of history, were destined to take their place in the front rank of the nations of the world.

But what has become of these forests? In the east, alas! except for an occasional woodlot on the farms, not an untouched acre is left of over 600 millions of acres of those virgin forests—as any traveler between the Atlantic Seaboard and the Mississippi can see for himself. They have been all but wiped out. Of the original 681,000,000 acres of virgin hardwood and pine forests in the east, only 60,700,000 acres remain. Of the 140,800,000 virgin softwood forests of the western and Pacific States, only 77,400,000 acres remain. In other words, about five-sixths of the virgin forests of the United States no longer exist.

Photograph by E. D. Swan, Courtesy U. S. Forest Service

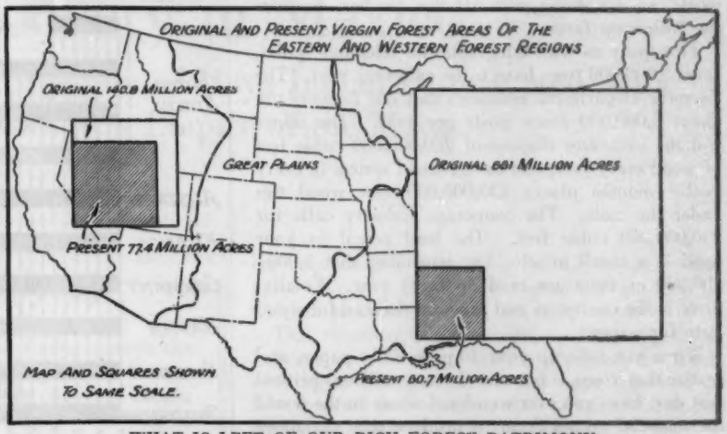
REPAIRING THE HAVOC

Planting crew of the Forest Service setting out seedlings on burnt-over forest land, St. Joe, Idaho



OUR FORESTS AS THE PILGRIM FATHERS FOUND THEM

Three centuries ago the Plymouth and Jamestown settlers found 681,000,000 acres of virgin forest in the east. There were 140,800,000 acres, also untouched, in the west



WHAT IS LEFT OF OUR RICH FOREST PATRIMONY

Pioneer clearing for farmsteads; timber for homes, barns, fencing and firewood; the demands of industry; wasteful lumbering; decay and forest fires, have done their work

Several causes have contributed to this disaster. In the first place, the pioneer was, perforce, under the necessity of clearing the land if he was to have a home and a farm. That was unavoidable. Then, as the country grew in population, timber was required for house building, farm fencing, et cetera, and with the advent of the railroad and the development of manufacture, the professional lumberman organized his forces and, with never a thought for the future, cut down the forests with unbelievable wastefulness, selecting only the best trees and leaving behind him a tangled desolation. To the spoliation of the lumberman's axe was added, moreover, the scourge of insect pests—a source of loss which grew in range and rapidity as intercourse with other parts of the world brought in alien pests that were not indigenous. Finally there was the scourge of forest fires which, once started, would blast their way for hundreds of miles, wiping out vast areas of valuable timber lands, at a loss which has reached $25,000,000 in a single year.

Present Condition of Our Forests

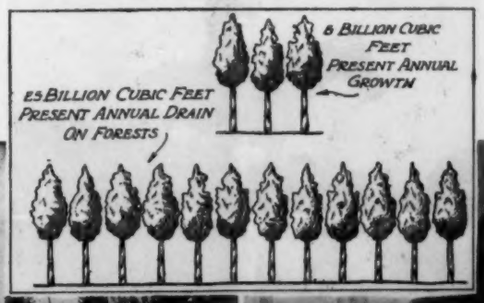
Let us now look more closely into the condition of our forests. Although we have only 138,100,000 acres of virgin forest remaining out of the original 821,800,000, it must not be supposed that the difference of 683,700,000 acres represents land that has been cleared and turned into farms. Of the virgin forests from which the merchantable timber has been removed, there are 250,000,000 acres that are more or less covered with a growth of young trees, which have been self-planted, but which are too small to have any commercial value. These great areas of cut-over forests have been left to themselves and are liable to be swept at any time by forest fires, as indeed they frequently are. In addition to this, there are 81,000,000 acres from which the forests have been removed, and whose soil is such that the land is entirely barren and unproductive of anything whatsoever. With the forest growth removed, especially where the ground is steep, there is a rapid run-off of the rainfall with a consequent washing away of the soil. On many such tracts of land, the surface soil has largely disappeared. Where this has occurred, the moisture is no longer held back and permitted to find its way gradually to the streams and rivers; but its descent is so rapid and uncontrollable that sudden and disastrous floods frequently occur.

There is another serious condition resulting from forest depletion which is too often forgotten—namely, that the great industrial states of the northeast and the central and lake states are now far removed from the remaining sources of timber supply. Although these industrial states consumed forty-five percent of our lumber in 1920, they had to depend upon the railroads to bring in the needed timber from these far-distant centers in the extreme south and the extreme west. The average haul for southern lumber is 1,200 miles and for the lumber from the northwest, it is 2,750 miles. In these days of high freights, the cost of merely hauling this lumber runs into many hundreds of millions of dollars, the estimated cost of haulage last year being the enormous sum of $265,000,000.

We shall be the more deeply impressed with the uneconomical conditions to which the country has been brought by its spendthrift policy, or lack of policy, when it is stated that seventy-five percent of the virgin untouched forests of the country and sixty percent of all the forests, both virgin and natural second growth, are to be found in the remote Rocky Mountains and upon the Pacific Coast, and therefore far from our great industrial centers.

How Timber Is Consumed

The threat of the absolute wiping out of what is left of our forests will be understood when we consider the present enormous annual consumption of lumber, which amounts to 25,000,000,000 cubic feet, and compare it with the present annual growth of only about 6,000,000,000 cubic feet of new timber. If you are filled with wonderment as to what in the



Photograph by W. S. Cline, Courtesy of U. S. Forest Service

OUR FORESTS AND THE LUMBERMAN

LEFT: *Railroad ties cut from National Forest timber, stamped "U. S." by Forest officers, and charged at so much per tie.* CENTER: *For every tree grown, four are cut down.* RIGHT: *The drain on our forests is 25 billion cubic feet per year. Most of this is necessary; but there is much needless waste*

world we are doing with all this lumber, consider the following facts:

To supply us with telegraph and telephone poles, some 5,000,000 trees have to be cut every year. The Forestry Department estimates that our farmers use about 5,000,000 fence posts per year. The miner and the excavator dispose of 260,000,000 cubic feet of wood every year, and our railroad system in every twelve months places 130,000,000 new wood ties under the rails. The cooperage industry calls for 250,000,000 cubic feet. The lead pencil in your hand is a small article; but remember that 1,000,000,000 of them are used up every year. Finally, there is the enormous and growing demand for wood pulp for paper.

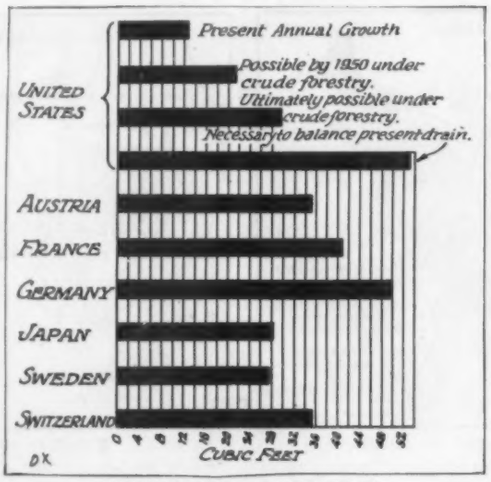
When you take up your 40-page daily paper, and realize that yours is but one of many millions printed that day, have you ever wondered where in the world the material comes from to produce this avalanche of reading matter? Of course you have. But how many of you realize that the material of your daily paper is wood pulp and that to keep up this enormous output, our soft-wood forests are being swept away. If you doubt it, let me refer you to the Forest Service which tells us that, in 1922, we consumed more than 8,000,000 tons of paper of all kinds; or more than all the other countries of the world combined. To make this total, 5,847,000 tons of wood pulp were required, and in making the pulp, 9,148,000 cords of wood were used up—and a cord, mind you, is a pile of wood four feet high, four feet wide and eight feet long.

Such is the present situation. What are we going to do about it?

We Must Become Growers

The answer to that question carries us back to the very beginnings of the nation when, here and there, a few far-seeing men found time to think about the future. Thus, we have William Penn's requirement that one acre of forest be left for every five cleared; and the ordinance of Connecticut, that lumber should not be taken out of the township. In 1799, Congress appropriated $200,000 for the purchase of a forest reserve containing lumber suitable for shipbuilding. Again, in 1827, our forefathers made an attempt to grow live oak for the same purpose. Then, gradually, the individual states began to think in terms of timber conservation until, in 1873, Congress passed the Timber Culture Act, which gave to any settler 160 acres if he would plant and maintain forty acres of timber in treeless sections.

The beginning of the present movement to conserve our forest dates from 1886, when the Division of Forestry was created. Commencing with a pitifully small appropriation of $30,000 or less, the work expanded until in 1901 the Division became the Bureau of Forestry. In 1905, the Bureau, in its turn, became what is now known as the Forest Service, whose appropriation for the year 1924 was $12,731,869.



DEATH KNELL IN A DIAGRAM

This diagram proves we shall soon have no forests left. Income, 12 cubic feet, outgo, 52 cubic feet, spells bankruptcy. Europe grows as much as she cuts

Hitherto, we have been a nation of woodcutters; henceforth, thanks to national legislation and our highly efficient Forest Service, we are learning to become a nation of wood growers. Only in this way can we avert disaster. European peoples have been nations of wood growers for centuries. Most carefully do they tend their forests; most scientifically do they cut the mature wood and plant the seedlings or young shrubs. To be convinced of this, look at the accompanying diagram. Under our present methods, our forests produce only 12.8 cubic feet per acre whereas, to meet our present consumption, they should produce over 52 cubic feet. European nations on the other hand, because of centuries of careful forestry, are growing as much timber as they cut, Austria and Switzerland producing nearly 36 cubic feet per acre, France, 40.5 cubic feet and Germany, 48 cubic feet per acre, per year.

Oh yes, the thing can be done if we will but cease to play the spendthrift and practice a little of the virtues of thrift.

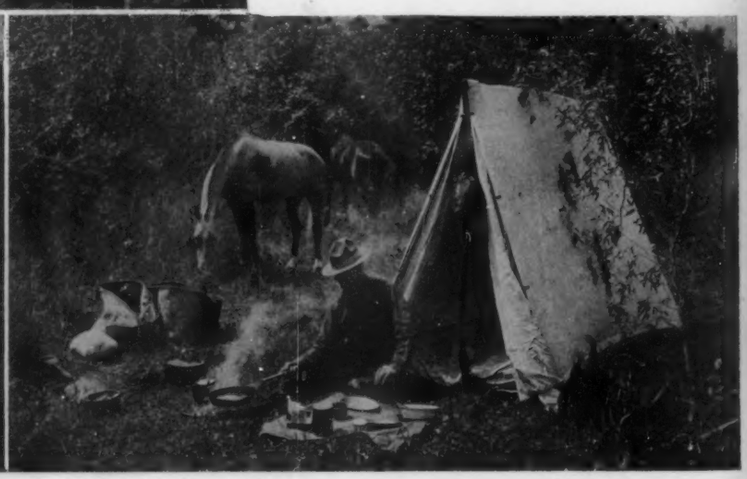
But wise legislation and the fine work of our Forest Service are stemming the flood of extravagance. Already the Government has set aside 149 national forests, containing over 156,000,000 acres, which it administers under the most up-to-date principles of forestry. Under what are known as the Weeks Law and the McNeary-Clarke Forestry Bill, provision is made for the purchase of additional forest lands; for federal co-operation with the states in fire protection, and for forest activities designed to promote forest growth.

Of the activities of the Forest Service, it is hardly necessary to speak at any great length; for in previous issues we have made them familiar, particularly in the article on forest fires which was published in our issue of July, 1925. Forest fires have been the greatest source of loss, some 2,000,000 cubic feet having been wiped out in a single year. Forest rangers, of which there are 4,000 in the western forests, alone, are a selected body of men especially trained for their job. A close watch is maintained from lofty lookout points, and from patrolling airplanes. So strict is this watch that an incipient fire is quickly detected. A telephone call suffices to assemble trained bodies of fire fighters at the danger point.

A Job of Vast Magnitude

Equal in value to the preventive work of the Forest Service is its constructive work in cleaning up and replanting the millions of acres which have already been devastated by fire and by the axe of the lumberman.

Before we shall learn to become a nation of wood growers, the present widespread campaign of education must be intensified. Thanks to the Forest Service and the several patriotic societies which are at work, every citizen of the United States who can read or appreciate the meaning of a photograph must, by this time, be more or less familiar with this great national problem of forest conservation. But the good work has only begun. There are fourteen states that have no organized forestry. The Federal appropriations are meager in comparison with the magnitude of the work. There is still a big job to be done. This job must be done in a big way.



Photographs Courtesy of U. S. Forest Service

THE FOREST RANGER—FAITHFUL GUARDIAN OF OUR FORESTS

LEFT: *Grazing on Forest Reserves is regulated and a fee charged. Forest officers counting sheep as they enter Reserve.* CENTER: *Mounted Forest Ranger looking for forest fires.* RIGHT: *Tent pitched, horses turned loose, the Ranger cooks his supper*

A New Maya Discovery in Mexico

A Remarkable Find that May Alter Our Interpretation of Maya Indian History, and Set a Closer Date to the Founding of the New Empire of the Mayas

By Thomas Gann
Fellow of the Royal Geographical Society
Fellow of the Royal Anthropological Institute

THE stela shown in the accompanying photographs was discovered by me on January 6, 1926, on the east coast of the Chetumal Bay, in Quintana Roo, Yucatan, while searching for Maya ruins along the coasts of the bay. These coasts are completely covered with forest down to the seashore, and with the exception of a few huts of Maya fishermen, they are entirely uninhabited.

The stela consisted of a block of shale nine feet long, eighteen inches broad, and twelve inches thick. Most fortunately it had fallen upon the side bearing the Initial Series, which had consequently been protected from the weather, and was found to be in a remarkably good state of preservation.

October 26, 333 A.D.

The first glyph, which owing to the slope of the stone does not show well in the photographs, is undoubtedly the Initial Series introducing glyph, the superfix, *katun* sign, and trinal subfix being easily identified.

The second glyph is the face variant for the *Bactun*, showing the hand in place of a lower jaw. The numerical coefficient of this glyph shows half a bar and two dots, the upper half of the bar and the upper two dots having been broken away. It was unmistakably 9.

The third glyph is very clearly the face variant of the *katun* sign, with the numerical coefficient 8—a bar and three dots.

The fourth is the face variant for the *Tun*, with fleshless lower jaw, and numerical coefficient zero.

The fifth, the *Uinal* sign, like the full figure glyphs at Quirigua, exhibits the entire body of the frog, with projecting feet; the zero sign placed in front of the face. The *Kin* sign is badly damaged, but its coefficient zero is unmistakable. Then follows the day 5 *Ahau*, and immediately beneath this, the month 3 *Chen*.

The complete Initial Series reads 9. 8. 0. 0. 0., 5 *Ahau*, 3 *Chen*, corresponding in Spinden's Correlation to the date 26th of October, 333 A.D.

This discovery is the fourth Initial Series date ever found in the whole peninsula of Yucatan, and if it is a contemporaneous date, as it appears to be, it is 14½ *katuns*, or nearly three centuries earlier than the next earliest date known in this region. The latter date was found at the great ruined City of Chichen Itza, and is 10. 2. 10. 0. 0.

This remarkable find would, in fact, appear to indicate that the Maya people occupied the south of Yucatan centuries before they were supposed to have deserted their southern cities of the Old Empire, and thus it may necessitate a complete revision of our present ideas as to their migration into Yucatan, and the founding at that time of their New Empire.

Much Yet to Learn

We still know comparatively little about the Mayan hieroglyphs, except the numbers, dates and a few other things. No key like the famous Rosetta Stone, bearing identical inscriptions in both a known and an unknown tongue, has yet been found. Thus our knowledge of the hieroglyphs is still confined practically to the identification of the numbers, the day and month signs, and some less important symbols.

An "initial series" is a reckoning which is carried back to a supposed beginning date, long before any recorded dates.

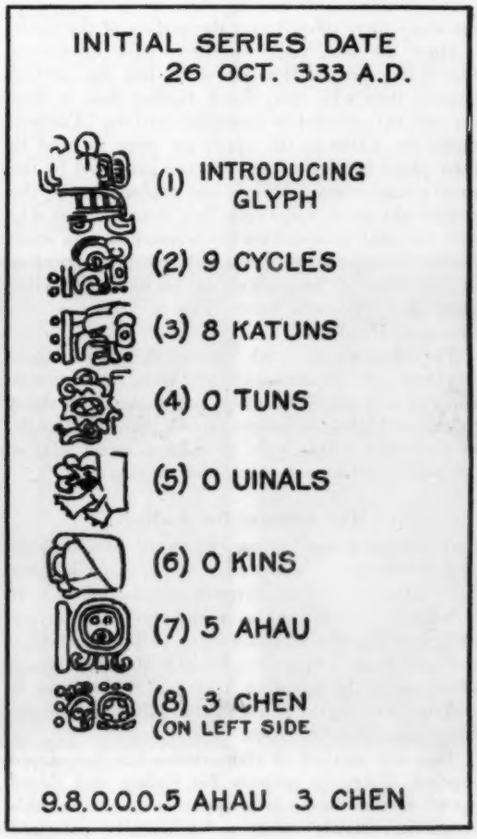
Mystery

The stela stands a few yards to the east of the central one of three vast, stone-faced, terraced pyramids, which are contained within a great semicircular wall or fortification, with an arc of about one and one-half miles formed by the sea coast. The height of this wall varies from three or four feet, where it has fallen, to twelve feet where it is intact. This reminds one strongly of the fortified cities of Tuluum and Mayapan, the former on the coast, the latter in the interior of Yucatan.

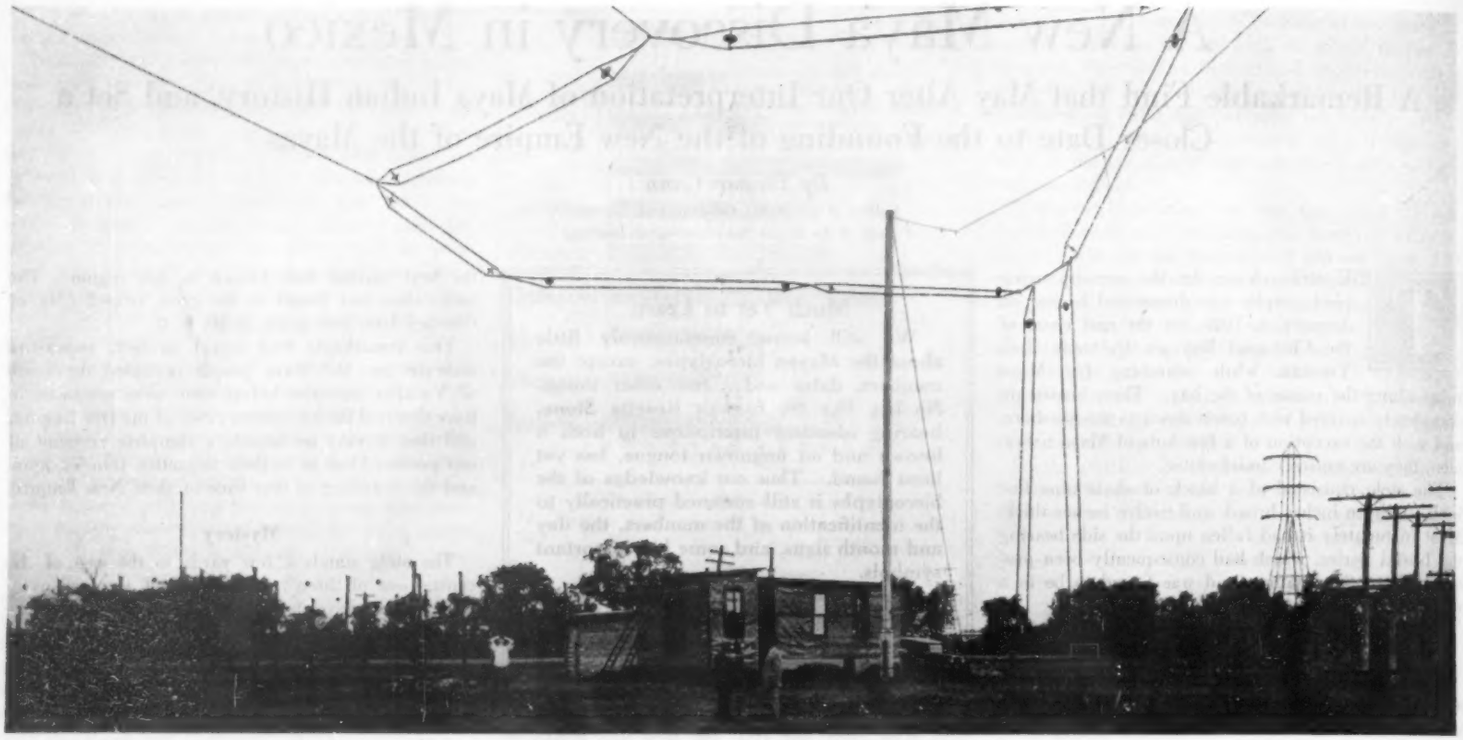
The whole site is covered with dense bush, but further exploration here is urgently called for in order to elucidate the mystery of this truly incomprehensible date.

The region must at one time have been densely populated, as it is simply teeming with such small objects such as potsherds, clay beads, and heads, both animal and human, Malacates, obsidian knives, flint chips and javelin beads, and so on. These are to be found everywhere lying on the surface of the ground when it has been cleared of bush and undergrowth.

UNKNOWN GLYPHS AT BASE OF STELA
Some day it is hoped that a clue which will enable all the glyphs to be deciphered will be found



DR. GANN AND HIS NEW STELA
A stela is an upright slab or pillar, bearing inscriptions. This one has fallen down



AERIAL FOR RADIATING CORKSCREW WAVES

This horizontal series-tuned loop aerial emits horizontally polarized radiation in all directions. The waves are projected at a high angle upward and thus this type of aerial is classified as a "high-angle radiator." High-angle radiation is useful in covering long distances

Shooting Radio Concerts Into the Sky

Experiments with a New Type of Wave, Which Twists in Space Like a Corkscrew

By Orrin E. Dunlap, Jr.

WHEN Paris was bombarded by the Germans during the World War a long-range gun was used which shot projectiles high into the upper atmosphere and over a distance of 75 miles. The rarefied air offered less resistance to the shells than the atmosphere offered near the surface of the earth.

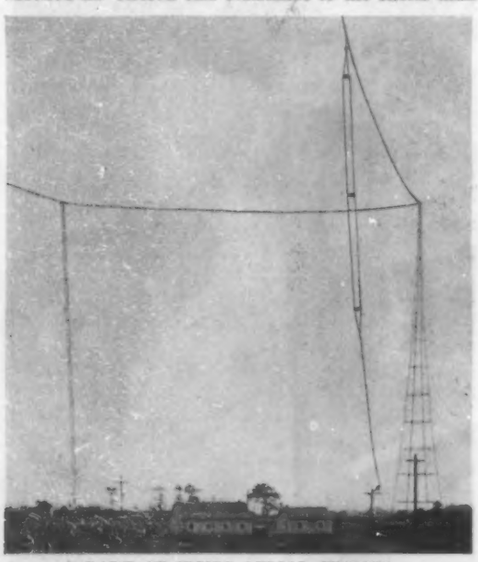
Since the war, radio engineers have discovered that if they project Hertzian waves into the rarefied regions they will carry much further than if they are sent out parallel to the earth's surface. Furthermore, the waves in the upper air seem to twist in their plane because of an influence produced by the earth's magnetism. This is one explanation of the reason why short waves spin long distances, but skip over the area surrounding the transmitter. In some cases the signals are not audible within a radius of 500 miles of the sending station but 3,000 miles away they are very loud. This is known as the "jump-over" effect.

The short-wave aerial that KDKA, Pittsburgh, employs for broadcasting to Africa and South America is a straight, vertical rod, designed to shoot the waves high into the sky, giving them high angle of radiation. This type of antenna gives almost complete vertical polarization of the waves.

May Account for Fading

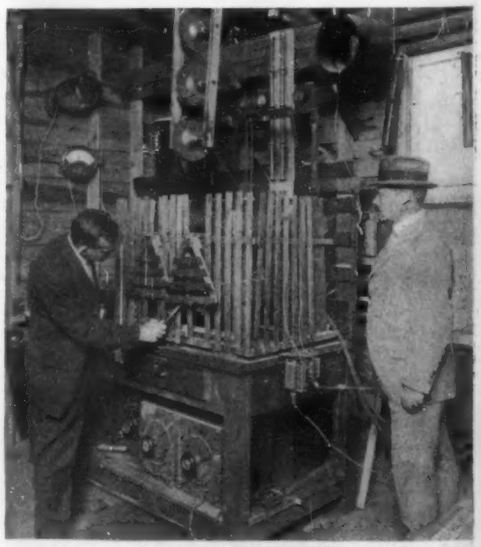
A polarized wave is one which vibrates only in one direction. A water wave is polarized because it vibrates in only one direction—up-and-down. It is believed that as long as a wave hugs the surface of the earth it will maintain its up-and-down motion, similarly to an ocean wave, because of an anchorage effect the globe seems to have, but if the wave is radiated into the upper regions, it will twist in corkscrew fashion as it moves.

This new method of transmission has introduced another theory to account for fading and "dead spots" in the ether. It is apparent that the earth's magnetism slowly twists a horizontally polarized wave's plane and that the various twists affect antennas differently. For example, the wave of a New York station might not be twisted just right to give up much energy by the time it reached Syracuse, but ten miles further on, the twist would be more favorable for antennas to intercept energy.



PART OF WGY'S AERIAL SYSTEM

At the left is a horizontal doublet suspended between two 300-foot masts. Two transmission lines, separated by insulators, lead from the broadcasting apparatus, one line to each half of the doublet. The two sections of the horizontal doublet are insulated from one another. At the right is a six-wire vertical cage aerial



A SHORT-WAVE EXPERIMENTAL STATION

So sensitive is this equipment to body capacity that the apparatus is housed within a cage and tuning is done by means of a wooden rod. Dr. E. F. W. Alexanderson, who is devoting much of his time to short-wave experiments, is at the right. The 41-meter signals have been heard in Egypt and other countries far distant from Schenectady

Therefore, Syracuse might be termed a "dead" area as far as the particular transmitter is concerned.

When waves are radiated horizontally along the earth's crust they are subject to absorption by trees, steel structures, wires and mountains which contain metallic deposits. These influences reduce the transmitter's range and decrease signal strength. In order to conquer the vagaries of the ether it seems reasonable to believe that fading could be minimized, "dead spots" penetrated, and louder signal intensity made possible if a broadcaster could be made to radiate two types of waves—vertical and horizontal —so that the receiver could benefit by the combined effect, or at least be certain of detecting one of the waves, although the other might fade.

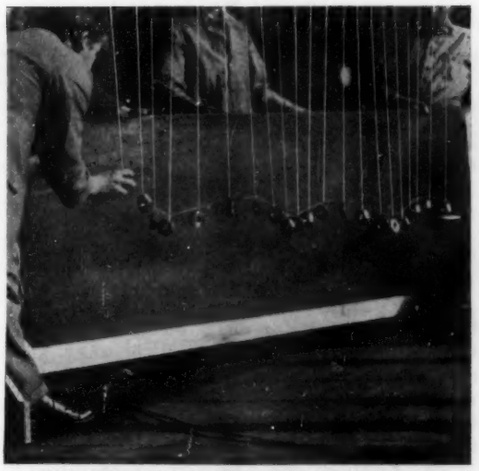
Dr. E. F. W. Alexanderson, in his laboratory at Schenectady, New York, is conducting experiments with horizontally polarized waves. He broadcasts vertical and horizontal waves, so that as the two waves travel away from the aerial their combined strength and individual characteristics aid in overcoming the ill effects which are detrimental to reliable radio reception.

To produce the horizontally polarized waves, Dr. Alexanderson employs a loop aerial, consisting of six, tuned units suspended in a horizontal direction, so that it will radiate a wave polarized in the plane of the loop. As these waves get further from their source, they twist in their plane and observations indicate that they first turn when they are ten to fifteen miles from the transmitter.

Stations May Use Several Wavelengths

Dr. Alexanderson says, "We have found that the space wave from a 50-meter station twists in its plane of polarization about 20 to 30 degrees in ten miles. From this we may conclude that it would acquire a twist of 180 degrees in 60 to 80 miles. It is therefore reasonable to assume that a space wave emitted from a broadcast station would acquire a twist of 180 degrees in 100 miles. The earth-bound wave, on the other hand, proceeding from the same station will maintain its vertical plane of polarization, due to the proximity and guidance of the earth. The earth wave and space wave may thus arrive 180 degrees out of phase and cancel each other.

"If all conditions were constant we would thus have a permanent 'dead spot' of reception such as is sometimes observed. Variations of the conditions which control polarization will, however, cause the signal to fade intermittently. From this reasoning it might be expected that these phenomena would



HOW RADIO WAVES TWIST IN THEIR PLANE

Twenty-two weights, arranged in a row and joined together by rubber bands are used to illustrate the polarized wave theory. Each weight is suspended from a yoke and an equal weight is hung from the other side as a counter balance, but shielded from view to avoid confusion in observing the wave motion, which is in a corkscrew fashion. This device was set up in the General Electric Laboratory

repeat themselves at a distance of 300 miles from the station where the plane has twisted another 360 degrees. At that distance, however, the earth-bound wave has been so largely absorbed that it is of a lower order of magnitude than the space wave and therefore cannot produce interference. Much will undoubtedly become known in the next few years which will enable us to predetermine more accurately the phenomena of shifting-wave polarization and fading."

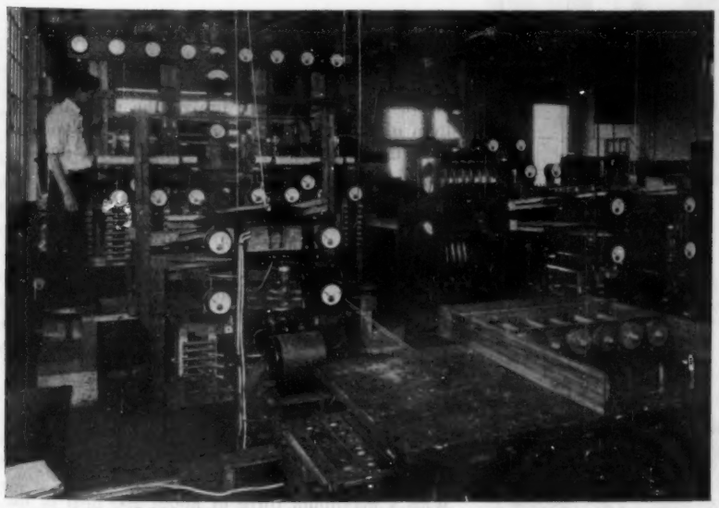
Some believe that when more is learned about horizontally polarized waves, the broadcasting stations will not use only one aerial, or one wavelength, but will adjust their transmitters to send out a certain wave for different hours in order to cope with the varying conditions caused by daylight and darkness.

Analysis of reports from broadcast listeners on comparative tests of horizontal and vertical radiation from a 30-kilowatt plant of WGY, indicate that the horizontal radiation gives better service in the zone from 60 to 250 miles from Schenectady, but at greater distances the vertical aerial radiation is more satisfactory. The letters testified that there is no enormous difference in the loudness of the signals produced by the two types of transmission. This seems to indicate that waves may leave an aerial vibrating in either a horizontal or a vertical plane and will then be twisted around until they give practically the same effects. It has been found that at a distance of about ten miles from a horizontal loop radiator, the wave comes down with an almost vertical direction of propagation. For those who believe in the Heaviside surface layer, Dr. Alexanderson points out that this seems to be good evidence that waves radiated high into the sky are reflected directly back to the earth when they strike the ionized region in the upper atmosphere.

So successful have been the tests at Schenectady that the Radio Corporation of America has decided to build a chain of short-wave stations to link the islands of the Pacific with the mainland. These stations will have aerial systems classified as short-wave, high-angle radiators. Already, six short-wave transmitters, installed in a temporary manner, are supplementing commercial long-wave stations. Signals on wavelengths between 15 and 30 meters have performed good service across the Atlantic during daylight hours. The best all-around service seems to be about 40 meters. Conditions for wave propagation across the Pacific are superior to those over the Atlantic and for that reason it is expected that a reliable short-wave service will be established between California and the Orient. Experiments will be conducted to determine which wavelengths are best suited for transpacific communication.

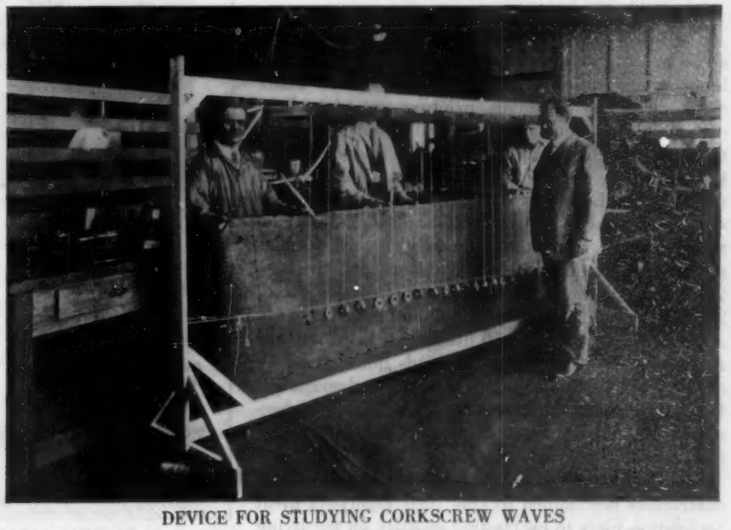
Comparative Tests Now Being Made

The experimental station, built near Schenectady by the General Electric Company for the purpose of exploring polarized and short waves, is capable of operating with seven transmitters simultaneously on different wavelengths and with different types of aerials. Observations of these transmissions are made all over the world. The object of these tests is partly to explore the propagation characteristics of different wavelengths and to make final tests of comparison between the various types of aerials. Three types of radiators are used in these experiments but they are the result of a sifting process conducted on a smaller scale in which many other aerials have been tested and temporarily discarded. The radiators now in use are: The straight, vertical aerial oscillating at a hermonic frequency; the horizontal aerial with an over-all dimension of one-half wave, fed in the middle through a transmission line and, third, the series-tuned, horizontal loop. All these radiators have one feature in common—they shoot the waves high into the sky.



APPARATUS FOR TESTING RADIO WAVE THEORIES

The 50-kilowatt plant of WGY, Schenectady. At the right is a 5-kilowatt transmitter used with the high-powered set for comparative tests. This experimental station has seven transmitters and various types of aerials for simultaneous exploration on different wavelengths



DEVICE FOR STUDYING CORKSCREW WAVES

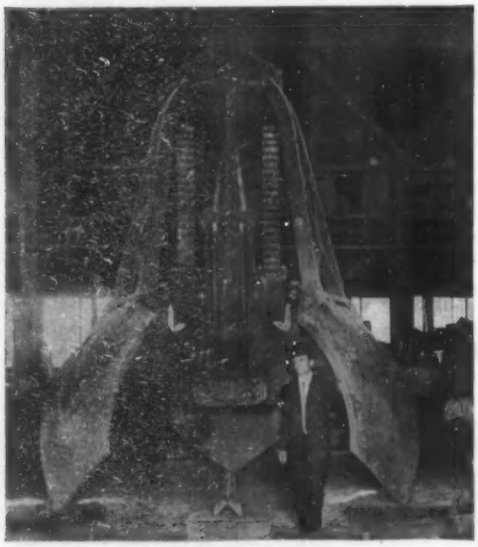
This mechanical model has been set up by Dr. E. F. W. Alexanderson for studying wave motion in the horizontal and vertical planes. It shows that if a wave is started in a plane of 45 degrees between the vertical and horizontal planes it assumes the shape of a corkscrew

Diving Through Mud to Rock

By Frank W. Skinner

FOR many years the material excavated from cellars, grading and subways, sewer and water trenches and the like—millions of cubic yards of earth and rock—has been used to fill in low and wet ground. This filling-in process, together with the natural movement of sand by the waves, has built out the shores of New York Bay and the North River until the shore line is now blocks farther out than it was formerly, and whole streets have been built on the made land.

This reclaimed area is so immensely valuable that wherever the bearing value of the surface is inadequate to carry a lofty skyscraper, engineers do not hesitate to incur the heavy expense of carrying the foundations down to the underlying rock. The loads are often vastly increased by wind pressure, vibrations and other special stresses—conditions that would soon completely wreck a tall, heavy building, just as surely as would a violent earthquake, if the foundations of the building were not absolutely enduring and unyielding.



DAVID AND GOLIATH

Huge orange-peel dredge, capacity five cubic yards, with (beneath it) a miniature hand-operated dredge

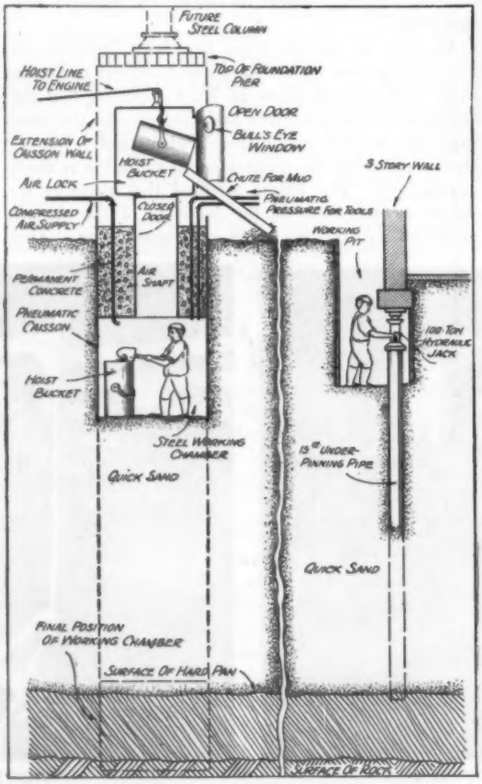
The sixteen-story Evening Post Building, at West and Carlisle Streets, New York City, will contain immense quantities of heavy machinery and materials, including enormous printing presses, whose continual operation must cause vibrations requiring the most substantial and immovable foundations to transfer them safely to the deep underlying bed rock. Here, hundreds of feet beyond the original shore line, above long-forgotten docks and piers, sunken wrecks, stone, timber and debris buried under many feet of mud and earth and sediment, there is, 20 feet below the surface, a vast bed of quicksand, 30 feet thick. This bed of quicksand covers a hard, irregular crust perhaps 10 feet thick over the bed rock, to which the foundation loads must be safely carried. An inexhaustible flow of water through the loose sand makes impossible the digging of deep open pits; and the depth and the large quantities of debris obstructing the soil prevent pile driving.

Nothing daunted, the engineers, architects and contractors determined to sink their eighty-six great foundation piers to everlasting security on the living rock, or on well proved hardpan overlying it. This they did by means of great diving bells that gradually burrowed their way down from the surface, as the tall concrete shafts were built on their roofs. The shafts were always maintained above the surface of the ground. They were filled solid with a concrete that will grow stronger and stronger year by year.

The stone foundations of old light buildings and about 2,500 yards of earth and debris were removed by a steam shovel that dug a pit about nine feet deep down to ground water level, in which were erected groups of small wooden towers. On these were installed four great derricks, with 50- and 60-foot booms, capable of reaching to every corner of the lot and of handling ten-ton loads from the streets. Eighty-six steel pneumatic caissons, about 8 feet high and from 5 to 16 feet in diameter or length, according to whether they were round or square, were used. These bottomless, air-tight boxes were the diving bells in which men, the "sand hogs," worked under an air pressure which was sometimes twice as great as that of the free atmosphere.

How the Caissons Were Sunk

The derrick booms, operated by electrically driven hoisting engines, always ready for instant, silent work, swiftly swung the heavy steel caissons to exact position. The sand hogs entered, dug up the bottom and loaded it into buckets. The buckets were hoisted out through chimney-like, vertical steel shafts, surmounted by chambers called air locks, with double doors, one of which was always closed to prevent loss of air pressure. The bottom was undermined so that the caissons sank, a few inches an hour, safely and steadily, through the treacherous quicksand and flowing water that could not rise up in the open bottom because it was constantly pushed back by the compressed air that filled the chamber.



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At left, foundation cylinder is being sunk to rock. At right, sinking underpinning pipe below wall of building

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Some of the caissons were sunk so close to a neighboring three-story brick building that there was possibility of undermining its shallow foundations, a danger that was averted by first supporting its adjacent wall on a row of steel and concrete columns built under it and carrying its weight securely down to the hardpan or rock independent of any movement of the treacherous sand on which it rested.

Pits just big enough for two men to work in were dug close to the wall and carried down a few feet

PREPARING FOUNDATIONS FOR SKYSCRAPER

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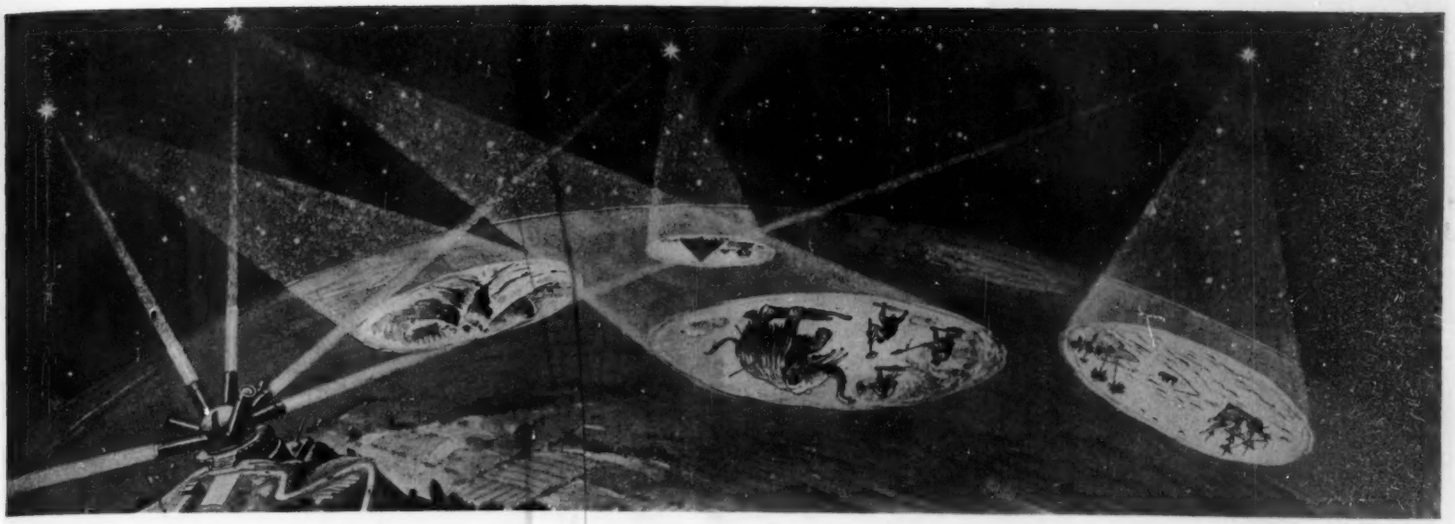

The Super-Telescope

A Scientific Fantasy of the Past and the Future

By M. Luckiesh

Director, Lighting Research Laboratory, National Lamp Works of the General Electric Company

IMAGINE a super-telescope which would not only penetrate for our eyes the remotest confines of the universe but would turn back the pages of history. Heretofore, improvements in telescopes have merely pushed back the veil further and further. The unaided eye can see only about 3,000 stars from one viewpoint. Galileo with his small telescope, possessing an objective lens two and one-quarter inches in diameter, multiplied the number of visible stars a hundred fold. The large telescopes of the present time have multiplied the number of visible stars a hundred thousand fold.

But why be satisfied with just seeing celestial bodies and their details? Why not imagine the super-telescope which would give us a view of the past history of the earth at any page we desire; one that would provide us with a motion picture of the ages? Such a super-telescope appears possible and even probable.

Can We Amplify Light Images?

Today, telescopes depend for their magnification solely upon optical means. But those of us who are familiar with scientific phenomena learn to think in terms of electrical magnification as the method of almost infinite magnifying possibilities. When we desire to detect something very small, and if we are able to make one of the steps in the process electrical, the range of the apparatus is likely to be very great. Radio as known to most of us is proof of this point. Then why not imagine that some day the telescope will have its magnifying power enormously increased by the introduction of a link consisting of electrical magnification? Surely this is plausible, possible, and perhaps probable.

Having such an instrument, what shall we do with it? The nature of the so-called "canals" on Mars would be settled. Next, we might search the remote regions for other galaxies. This would indeed be wonderful but would it compare with seeing our own past ages in actual motion pictures?

What would compare with the thrill of witnessing Caesar leading his legions into battle or Cleopatra in royal splendor upon the Nile? What thrills there would be in viewing the *unwritten* pages of our history—our earliest human ancestors in their pursuitsor the huge reptiles of the bygone ages in deadly combat? As we sat upon Pike's Peak with this super-telescope, how marvelous it would be if we could see the Rocky Mountains actually being formed! Perhaps we should not be so ambitious as to extend our view back as far as such geological epochs. At least, let us see how this might be accomplished.

DR. LUCKIESH IN HIS STUDY

He is best known as the author of "The Foundations of the Universe" a semi-popular scientific treatise

Using this super-telescope with its enormous magnifying power, we merely take advantage of the finite velocity of light. Of course, to most of us light seems to travel from one place to another instantly, because its velocity (186,000 miles per second) is so great. Nevertheless when viewed in terms of stellar distances, light travels relatively slowly. It takes it eight minutes to come from the sun to us. In other words, we see events on the sun eight minutes after they have occurred. A collision of two remote celestial bodies which resulted in a sudden creation of light would be a wonderful scene. As watched through this telescope we would not see the light travel through space but we would see dark bodies suddenly become luminous by this light, one after another as their distances were greater and greater from the new source of light.

If we searched the celestial bodies near the earth for a minute mirror—a facet of a crystal or a plane surface of molten material—we could see ourselves in that mirror if it were properly oriented (and if we waited long enough). By means of other minute mirrors oriented at slightly different angles we could see other parts of the earth. If we viewed a mirror surface on Polaris or a body about equi-distant we would see events which actually took place there 75 years ago because it takes light 75 years to reach us from such a distance.

Seeing Past Events in the Future

By choosing the proper mirror we could witness, by reflection, events which took place on our earth 150 years ago. If we could do this now we might see the Revolutionary War beginning; we might see battles actually being fought which are now famous in our history. Rigel is 466 light-years away. If we could sit on that star with our electrical telescope, we would have to wait 33 years before we could see Columbus with his tiny ships approaching the shores of this country for the first time. From a mirror as far away as the small Magellan cloud we would see far into and perhaps beyond the Old Stone Age. Recent measurements indicate that certain celestial bodies are a million light-years away. In a mirror on one of these, earth-events which took place two million years ago might be witnessed.

All this appears possible, barring adverse atmospheric conditions. At least these paragraphs give us a vivid picture of the finiteness of the velocity of light. They stimulate the imagination and help us to gain an idea of stellar distances and their relation to time in terms of earth-events. When thought of in terms of electrical magnification, this super-telescope appears to be a scientific possibility.

Who can say that our children, or even some of us, may not witness the great motion-picture of the ages? Written history may then have its gaps filled and its errors corrected. But better still, future human beings may see the happenings with their own eyes and the countless centuries of unwritten history which have heretofore been concealed from human eyes, may be revealed.

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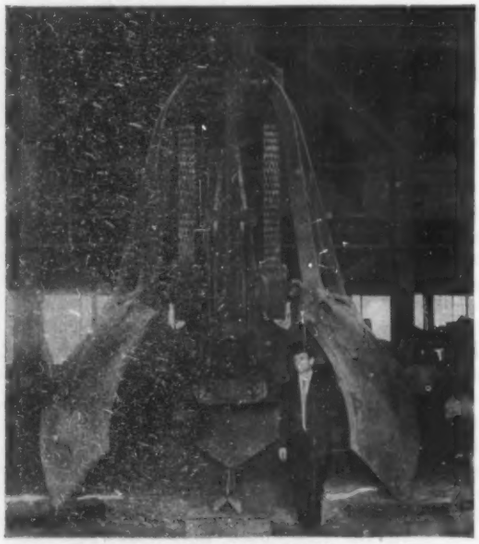

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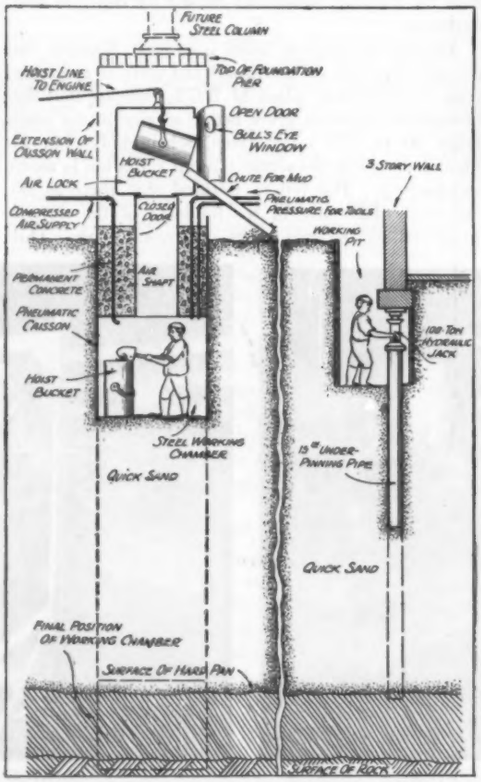

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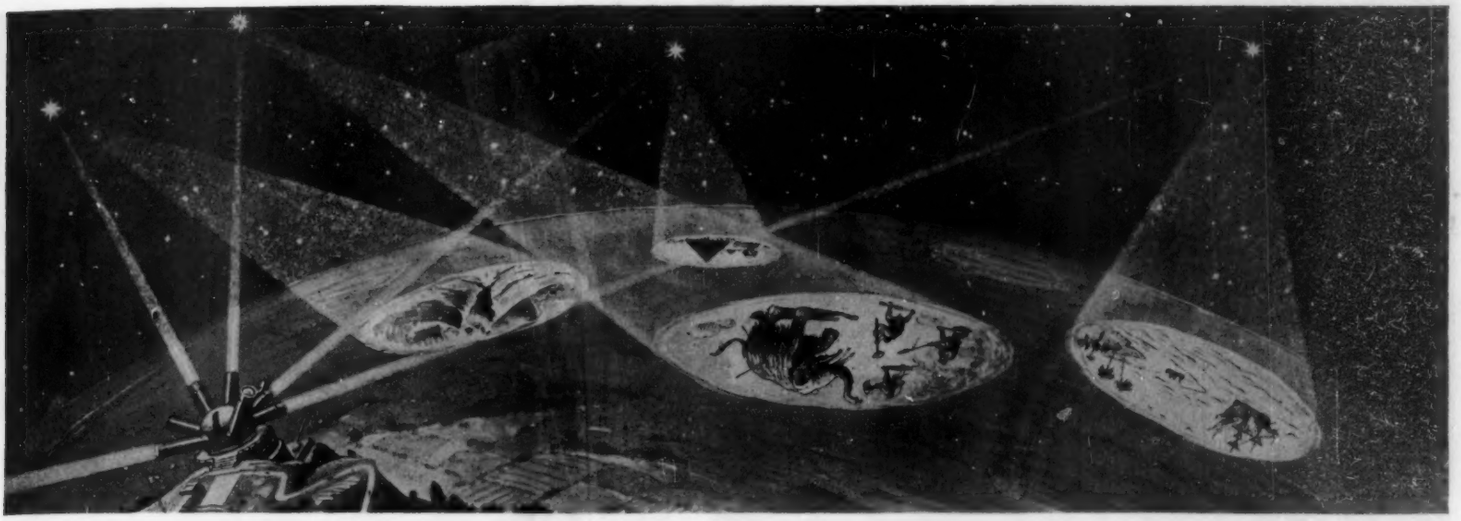

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By M. Luckiesh

Director, Lighting Research Laboratory, National Lamp Works of the General Electric Company

IMAGINE a super-telescope which would not only penetrate for our eyes the remotest confines of the universe but would turn back the pages of history. Heretofore, improvements in telescopes have merely pushed back the veil further and further. The unaided eye can see only about 3,000 stars from one viewpoint. Galileo with his small telescope, possessing an objective lens two and one-quarter inches in diameter, multiplied the number of visible stars a hundred fold. The large telescopes of the present time have multiplied the number of visible stars a hundred thousand fold.

But why be satisfied with just seeing celestial bodies and their details? Why not imagine the super-telescope which would give us a view of the past history of the earth at any page we desire; one that would provide us with a motion picture of the ages? Such a super-telescope appears possible and even probable.

Can We Amplify Light Images?

Today, telescopes depend for their magnification solely upon optical means. But those of us who are familiar with scientific phenomena learn to think in terms of electrical magnification as the method of almost infinite magnifying possibilities. When we desire to detect something very small, and if we are able to make one of the steps in the process electrical, the range of the apparatus is likely to be very great. Radio as known to most of us is proof of this point. Then why not imagine that some day the telescope will have its magnifying power enormously increased by the introduction of a link consisting of electrical magnification? Surely this is plausible, possible, and perhaps probable.

Having such an instrument, what shall we do with it? The nature of the so-called "canals" on Mars would be settled. Next, we might search the remote regions for other galaxies. This would indeed be wonderful but would it compare with seeing our own past ages in actual motion pictures?

What would compare with the thrill of witnessing Caesar leading his legions into battle or Cleopatra in royal splendor upon the Nile? What thrills there would be in viewing the *unwritten* pages of our history—our earliest human ancestors in their pursuits or the huge reptiles of the bygone ages in deadly combat? As we sat upon Pike's Peak with this super-telescope, how marvelous it would be if we could see the Rocky Mountains actually being formed! Perhaps we should not be so ambitious as to extend our view back as far as such geological epochs. At least, let us see how this might be accomplished.

DR. LUCKIESH IN HIS STUDY

He is best known as the author of "The Foundations of the Universe" a semi-popular scientific treatise

Having this super-telescope with its enormous magnifying power, we merely take advantage of the finite velocity of light. Of course, to most of us light seems to travel from one place to another instantly, because its velocity (186,000 miles per second) is so great. Nevertheless when viewed in terms of stellar distances, light travels relatively slowly. It takes it eight minutes to come from the sun to us. In other words, we see events on the sun eight minutes after they have occurred. A collision of two remote celestial bodies which resulted in a sudden creation of light would be a wonderful scene. As we watched through this telescope we would not see the light travel through space but we would see dark bodies suddenly become luminous by this light, one after another as their distances were greater and greater from the new source of light.

If we searched the celestial bodies near the earth for a minute mirror—a facet of a crystal or a plane surface of molten material—we could see ourselves in that mirror if it were properly oriented (and if we waited long enough). By means of other minute mirrors oriented at slightly different angles we could see other parts of the earth. If we viewed a mirror surface on Polaris or a body about equi-distant we would see events which actually took place there 75 years ago because it takes light 75 years to reach us from such a distance.

Seeing Past Events in the Future

By choosing the proper mirror we could witness, by reflection, events which took place on our earth 150 years ago. If we could do this now we might see the Revolutionary War beginning; we might see battles actually being fought which are now famous in our history. Rigel is 466 light-years away. If we could sit on that star with our electrical telescope, we would have to wait 33 years before we could see Columbus with his tiny ships approaching the shores of this country for the first time. From a mirror as far away as the small Magellan cloud we would see far into and perhaps beyond the Old Stone Age. Recent measurements indicate that certain celestial bodies are a million light-years away. In a mirror on one of these, earth-events which took place two million years ago might be witnessed.

All this appears possible, barring adverse atmospheric conditions. At least these paragraphs give us a vivid picture of the finiteness of the velocity of light. They stimulate the imagination and help us to gain an idea of stellar distances and their relation to time in terms of earth-events. When thought of in terms of electrical magnification, this super-telescope appears to be a scientific possibility.

Who can say that our children, or even some of us, may not witness the great motion-picture of the ages? Written history may then have its gaps filled and its errors corrected. But better still, future human beings may see the happenings with their own eyes and the countless centuries of unwritten history which have heretofore been concealed from human eyes, may be revealed.

Photographs made especially for the Scientific American by Thomas C. Turner

A TYPICAL TROUT STREAM. TROUT SWIM UPSTREAM, JUMPING THE RAPIDS, AS SPAWNING TIME APPROACHES

Down On the Fish Farm

Whether You Catch Him in the Brook or Order Him at the Hotel, Your Trout's First Home Was the Hatchery

By Milton Wright

ON the platter the waiter set down before us reposed a broiled trout. Nestling against its festoon of parsley it glistened with the golden melted butter running down its sides. We slipped our knife under the skin to lay bare the firm white meat, visioning as we did so the hip-booted angler in some mountain brook casting his bright colored fly to lure this morsel to our table.

Then, imbedded in the fish's tail, we saw a small metal tag with the letters "NYSCCO" and our picture of the fisherman vanished. This brook trout had never seen a brook.

The Complete Hatchery

Back of that metal tag lies not a fisherman's adventure, but another story—the story of an important and growing industry. To get that story the writer and the photographer sought a typical fish hatchery. Such a one they found in Paradise Valley up in the Pocono Mountains. It was ideally suited to their purposes, for it not only was the largest commercial institution of its kind in the country, but it was complete, supplying hotels, restaurants and markets with trout for food, furnishing fish eggs to most of the state conservation commissions and selling small trout to wealthy sportsmen and fishing clubs to stock their streams.

As with every hatchery, the water supply is all important. Preferably it should be spring water free from limestone. Here are ten mountain springs bubbling up water incredibly soft, all converging into one rapidly flowing pool with sluices and gates to control the supply readily in the event of freshets. Below are a score of pools surrounding a long wooden hatchery building, the whole enclosed by a strong, high wire fence to keep out the poachers who from time to time seek to raid the finny treasure.

Each pool is at a lower level than the one preceding it, the water from one spilling down into the next and so becoming aerated. Some are lined with concrete, others with common earth. L. H. Spragle, executive in charge of the plant, believes the latter conducive to the best results. Wooden planks are likely to rot and pollute the water. Each pond is an elongated hexagon in shape. Were it rectangular the water would be likely to lie dormant in the corners, the current running through the center. Each pond is cleaned frequently by draining off the water and sweeping out the sediment with a broom.

STRIPPING

Eggs from the females and milt from the males are squirted into the same pan and mixed with water before fertilization takes place

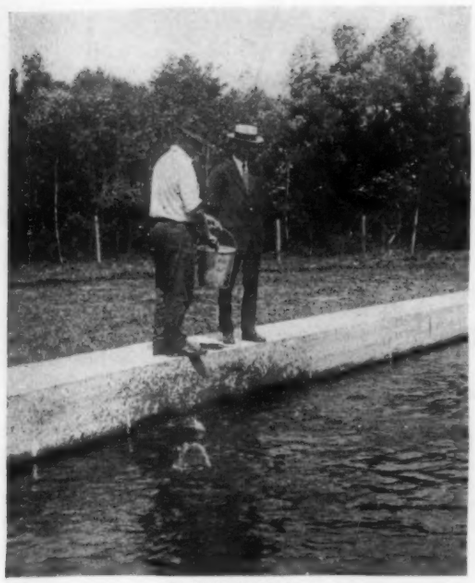
Trout swim thickly about in each pool, the big fellows in one, smaller in another, still smaller in a third, and so on. If by some chance a large trout wiggles through a wicket into a pond of smaller ones, every man of the organization drops whatever he is doing and joins in the chase after that one trout. He is a cannibal and if he should be left undisturbed there soon would be none of the little trout left. If necessary, they shoot him.

Two Years in the Pools

As the fish grow they are thinned out in order to give them more room. In sorting them, a box with brass rods for the bottom is used, very much like a box used for sorting oranges. This is shaken under the water, letting the smaller fish drop through and the larger ones remain in the box. The rods can be adjusted to let fish of any desired size slip through.

In these pools the fish are carried along until they are two years old. The water, coming out of the ground close by, is warmer than the air and never freezes over, except in the last pond, where it is so deep the trout can swim about freely far below the ice. In the spring time they are fed twice a day; in warm weather this is cut down to one meal a day and the one-time rate keeps up until the following spring. For the older fish the food consists of chopped beef hearts or sheep pluck. In some hatcheries chopped fish is used for food.

Brook trout for market are designated by their weight; those that run four to the pound are known as quarters, three to the pound as thirds, two to the



FEEDING TIME

Chopped beef hearts is thrown into the pond with a tin dipper. The trout swarm about. Note how they splash the cement wall

pound as halves. Only occasionally is a hatchery trout more than a three-quarter, for the demand for larger trout both for food and stocking purposes is limited. In natural streams, of course, trout grow considerably larger. In Maine they have been caught weighing as much as twelve pounds, with four and five pounders not uncommon. It is interesting, by the way, to note that scarcely a day passes when the fishing season opens, without several fishermen who have had no luck in the brooks, coming to the hatchery to fill up their creels.

November is the spawning time. The trout are caught in nets and carried in tubs into the hatchery building, where there are two divided troughs. Into one end of a trough the fish are dumped. One man, acting as a stripper, grasps the fish, tail down, with his left hand, and rubs his right hand firmly, pressing not too hard, down the fish's belly. From the female fish, from four hundred to six hundred eggs squirt. Each cream-colored egg is about half the size of a pea. The milt from the male fish is stripped in a similar manner into the same pan. After each fish is stripped it is tossed into a trough of running water, the males into one trough, the females into another.

After handling about thirty of the three-year-old females the stripper has a quart and a half—or 15,000 to 18,000—of eggs. These eggs, together with the milt from the male fish—buck is the colloquial term for him—are then washed, spread on a screen-bottomed tray and leveled off. The dead eggs are picked out. A pair of little wooden pincers is sometimes used for this. A better method, however, is to take a small syringe, blow about until you find a dead egg, suck it in against the mouth of the syringe and blow it off to the floor or in a refuse basket. A dead egg may be recognized by its color. From a cream tint it has turned white. If it is not eliminated from the others it will contaminate them.

Washing the eggs enables them to fill up with water, a condition necessary to their fertilization by the milt they have been mixed with. Each tray is then set gently into one of the many hatching troughs that fill the building. These troughs are the incubators—the home of the embryo trout until they graduate from eggs into "fry." They must be handled as little as possible, although every other day they must be sorted over and dead ones removed. The warmer the water is the sooner they will hatch.

The Hatching of a Fish

In 30 to 45 days the eggs begin to "eye up." Two black spots appear; they are the eyes, the first part of the creature to show in the hatching process. Just before the appearance of the eyes there has been a change of color, the creamy tint deepening to a sort of salmon. The eyes grow stronger, the body develops and in 20 to 45 days more the eggs hatch and the tiny wisps of shell fall through the tray's mesh bottom.

Each tiny fry comes free of his shell carrying his own lunch basket. This is a sac attached to his abdomen and it holds the nourishment he absorbs as he grows. The food sac gets smaller as the trout grows larger until the sac is completely absorbed. Then the baby trout at this stage swims up to the top of the water and dives about as if looking for food. This is about 35 days after he has hatched from his shell.

His first food is beef liver. This is skinned, the sinews removed, and then run through a fine food chopper six or seven times. As the fish grow, the quantity of food is increased and is ground less fine. At first the fish are fed five times a day. This is gradually cut down to twice a day, but the quantity at each meal is considerably larger.

Until spring the fry are kept in the troughs. Then they are put in brooding pools and as they grow they are thinned out to give them more room. When they get to be the size of a man's finger they

SORTING TROUT

They are caught in the net and poured into a box with brass rods. The smaller ones drop through, leaving the larger ones behind

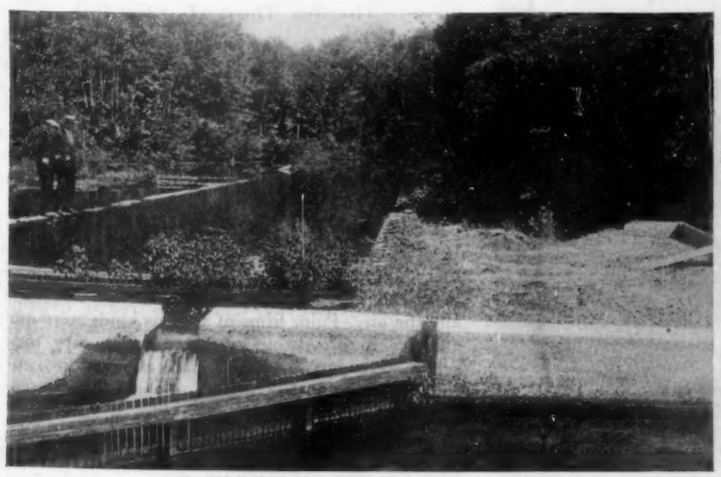
are called "fingerlings." They continue to grow and to be sorted into other pools until they reach the age of two or three years, when, with the help of the stripper, it is their privilege to achieve parenthood.

Such is the cycle of trout life at the hatchery.

A dull, prosaic sort of business, you say? Not a bit of it. Think of the natural enemies you have to outwit. A fish hawk swoops down, snatches up a trout, plays with it as a cat plays with a mouse, drops it in a field and then goes back for another one. Last summer the hatchery entered into an alliance with a small boy who liked to shoot a gun. At 25 cents a bird he brought down 80.

Or a blue heron comes at night, and the next night invites all his relations to join him. Or a kingfisher perches atop a fence post to survey his intended catch. The thing to do with him is to set a spring trap on the post.

Or a water snake makes trouble. There was one that worked its way through a valve and held his mouth up to a wire screen and drank in the small fish as they came against it. And there are eels and robins and catbirds, but they generally are content with the dead fish. But the small green heron, the frog, the barn rat—all are creatures of prey constantly to be fought.

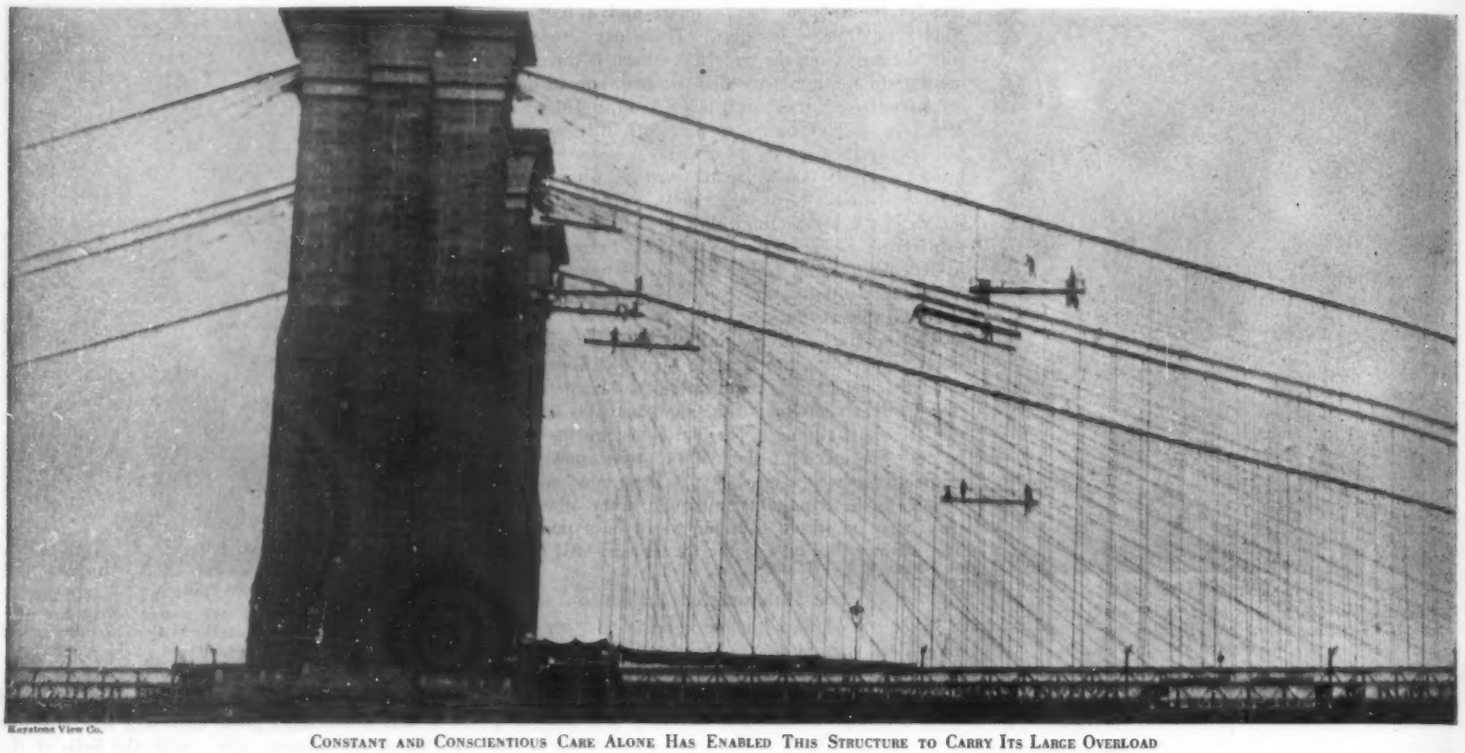


THE SOURCE OF THE WATER SUPPLY

Into the pool in the background ten mountain springs converge to be diverted to the ponds at the hatchery

TROUT PONDS ON THE HUNDRED-ACRE HATCHERY

This view of the ponds was taken from the hatchery building. Each pond gets its own supply of fresh water



Keystone View Co.

CONSTANT AND CONSCIENTIOUS CARE ALONE HAS ENABLED THIS STRUCTURE TO CARRY ITS LARGE OVERLOAD

$300,000,000 Annually Consumed by Rust!

Paint, While a Retardent, Is Not a Preventive. Only By Scientific Analysis of the Atom Structure Will Rust-proof Metals Be Developed

By D. H. Killeffer

Associate Editor, Industrial and Engineering Chemistry; Secretary, N. Y. Section, American Chemical Society

RUST prevention *looks* very simple. Perhaps that is the reason so many fantastic nostrums have been foisted upon an unsuspecting public to stop this universal waste. Perhaps, too, that is the reason scientists have disagreed so heartily and so long as to just the method by which it might be accomplished. Indeed, the inability of anyone to say exactly what corrosion is and how it acts has permitted our annual rust bill in the United States to mount to the astounding total of $300,000,000 annually! Structural steel, ships, railroads, water and steam pipes, the metal equipment of our industries, the multitudes of wires overhead and of cables below the ground and under the sea that make up the network of our communication systems, indeed every thing of metal that is necessary to our complex modern civilization is subject more or less to the ravages of corrosion and in the course of time adds its bit to the general waste.

Two Theories of Corrosion

The two theories of corrosion, which have formed the basis of much disagreement in the past on the subject, have each contributed methods of prevention which have succeeded to a certain extent and in that measure have been true. The difficulty has always come when the proponents of a partially true theory have tried to draw from their limited observations a version of that theory which would be universally applicable. Each investigator of the problem of corrosion has reached a theory based upon, and explaining, to his own satisfaction, the things he has seen himself, but lacking much of being able to explain all the observations of all investigators.

Early investigators supposed corrosion to be nothing more than simple oxidation of metal by the oxygen of the air. In fact, most statements of this theory compared corrosion definitely to ordinary combustion. Metal at ordinary temperatures was supposed to burn at a very slow rate, in much the same way that it can be made to burn like any other combustible material if heated sufficiently in the presence of air, or better, pure oxygen. The products of these two kinds of burning are quite similar except that that from low-temperature burning contains a certain amount of water in actual chemical combination which the other does not have, and that the one formed hot has been melted by the high temperature. Even these differences vanish if the low-temperature product is made hot enough to melt and drive off the water.

AN INSIDIOUS FORM OF RUST

As this form of rust is not open to inspection, even drilling tests may not develop the spot of maximum weakness

The New Theory Is Electrical

For the better part of a century, the simple theory, that a chemical action between the oxygen of the air and the metal itself was the sole thing involved in corrosion, served admirably to explain the problems which arose in regard to it. It was easy, for instance, to explain that corrosion was more rapid in damp atmospheres than in dry, for water has long been known to assist most chemical reactions.

On the basis of this oxidation theory and its many modifications, the method of preventing corrosion that offered most promise consisted in the simple expedient of putting a barrier between the metal and the air. Paint films of various kinds were quite effective in preventing rust so long as they themselves were perfect. Some paint films were better for this purpose than others. Sometimes rust continued to form even beneath a film of paint which seemed to be perfect. Other anomalies appeared as time went on and as the use of metals increased. The most serious of the difficulties encountered was that paint films had limited lives at best and had to be renewed at intervals if they were to continue

to protect the metal. This led to the development of metal coating methods which were based on the fact that some metals are less easily corroded than others.

Tin, nickel and zinc, and more recently lead, have been thus used in the form of thin films to protect iron from rusting. They have been successful in many cases, but, like paint, metal films have their faults. Perhaps the most grievous of these is that even a slight break in the coating will permit rusting to go on just as fast as before and sometimes faster than if the whole surface of the metal were exposed. It was not remarkable that the metal could be corroded through holes in the protective coating, but it was impossible to explain by the oxidation theory how corrosion could be so much more rapid at such points than it would be on a wide exposed surface.

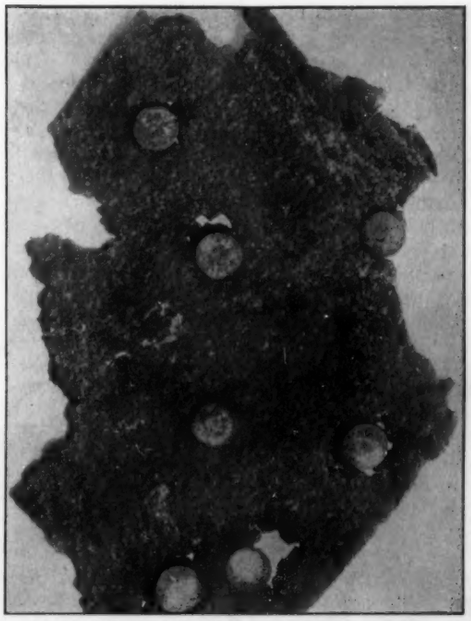
This theory and the preventive measures based on it were quite satisfactory during the last century. It was about 25 years ago with the advent of skyscrapers that steel began to be considered a structural material and consideration of corrosion began only about that time. Hence it was not until 1903 that a theory of corrosion which would explain many of the anomalies of the older one was seriously advanced. It was not strange, in view of the advances which had been made at that time in the fields of both chemistry and electricity, that the new theory should bear a rather definite electrical stamp. When it came, it sought to explain rusting by the simple application of electrical theory, and the electrolytic theory of solutions.

Briefly stated, this electrolytic theory supposes that corrosion is the result of the formation in the exposed surface of metal of multitudes of tiny electric cells as soon as it is exposed to moisture or to an electrically conducting solution, and that the generation of current in these tiny cells results in dissolving metal at some points and depositing hydrogen at others. The differences in chemical composition, and hence in electrical potential, necessary to start such action were readily found in any ordinary metal by the use of the microscope.

GALVANIZING NOT ALWAYS A DETERRENT

As this illustration shows, this galvanized iron pipe is rust eaten from within and without

Many of the impurities in metals separate themselves from the main mass and are of sufficiently different properties to assure the passage of current when the surface is wet. The separation of carbon from gray cast iron and of various impurities from other metals readily lead to the formation of such areas of different potential. In addition to this type of separation, many alloys show themselves under the microscope to be made up of areas of quite different composition. Thus, it was easy to explain the corrosion of almost any kind of metal so long as there was some moisture available to form the liquid element of the cells, as a basis for reaction.



POWERFUL CORROSIVE ACTION OF RUST

This corroded iron plate, so rust eaten that it must be handled with the utmost care to prevent disintegration, was uncovered recently on the site of an extinct iron foundry

After the metal had been dissolved by this electrolytic action—local action, it is frequently called—the oxygen of the air readily converted it into the oxide or rust. It is possible, too, to explain by this theory why corrosion is more rapid through holes in a protective film, for certainly the difference in electrical potential between the film and the metal is greater than between different parts of the same metal. The result of this theory from a practical point of view was the development of very pure iron as a rust resistant, for if there were no impurities present the chances for local action were certainly minimized. Unfortunately, however, it is possible for this very pure iron to rust under certain circumstances.

High Hopes for Preventing Corrosion

The "electrical potential" of a substance is really a very loose way of speaking of its "solution pressure." Solution pressure of a metal may be defined as its tendency to dissolve in a given solution, to throw off atoms as electrically charged ions. It is different for different metals in contact with the same solution and is also different for different solutions in contact with the same metal. The energy generated by an electrolytic cell is a measure of the differences in solution pressure at the two electrodes. In an ordinary dry cell, for instance, the energy generated, as measured by the voltage between the two poles, is proportional to the difference in the tendency of the zinc and carbon elements to dissolve in the sal ammoniac solution which fills the cell. Carbon has a very low solution pressure and zinc a comparatively high one. On this basis it is perfectly conceivable that certain metals and certain alloys of very low solution pressures may be found which would resist all ordinary efforts to corrode them, as gold does, for instance.

The solution pressure idea has led to another interesting advance in corrosion theory which seems to make the present theory broad enough to cover the entire field. This broadens the electrolytic theory, which had formerly considered only differences in the metal itself, to include differences in the solution in contact with the metal. Even slightest differences in solutions, such as are caused by the trifling amounts of oxygen that they will dissolve, are enough to make great differences in corrosion rates. For instance, if two identical pieces of iron be suspended in a weak salt solution and separated by a porous porcelain partition, a small but measurable current will flow through a wire connecting the two when air is bubbled up around one of them. This combination is called a concentration cell and operates by virtue of the differences in solution pressure of the same metal in contact with different solutions.

To show the relative amounts of corrosion which could be caused by concentration cell action and local action, recognized by the older theory, a concentration cell similar to that described was set up using ordinary iron and with a current measuring device in the line connecting the two electrodes. After this cell had operated for some time the loss in weight of the two electrodes was noted and the amount of loss which was caused by the cell action was calculated from the amount of current which had flowed. The current generated accounted for some 69 percent of the total corrosion loss and consequently only 31 percent was due to local action in the iron itself.

It is possible by this theory to account for the rusting of pipe lines buried in different kinds of earth along their length and for the rapid corrosion once a pit is formed in a metal surface. In the first case the difference in character of the water in soil of different kinds sets up concentration cells and in the latter case the easier access of air to the edge of a hole in the metal as compared with its bottom is sufficient to account for the formation of concentration cells which would cause a rapid corrosion of metal from the bottom of the pit. It is also possible in this way to account for the fact that a drop of water placed on a clean piece of metal will rust the center of the spot on which it rests leaving an unattacked ring around its edge where oxygen has free access.

It is true that these theories have not yet given us a sure and universal preventive of corrosion, but the agreement which has been reached among investigators concerning them now is sufficiently sure to permit the building of high hopes. A symposium on the subject held by the Corrosion Committee of the American Chemical Society last April was closed with the definite formation of plans for the building of an institution of research for the study in a thorough manner of corrosion problems. The institution which is to grow out of that meeting will be supported by users and makers of metals and is assured from its inception of the hearty support of the scientific world, a thing which would not have been possible ten years ago, so sharp were the disagreements on the subject.

A MENACE TO OUR HEALTH

Health depends in a large degree on our sewer and water pipes. Do we realize how rapidly rust deteriorates them?

GENERAL VIEW OF FURNACE CREEK RANCH, 170 FEET BELOW SEA LEVEL

A "Garden of Allah" In Death Valley

How Irrigation Will Cause Date Palms to Flourish in Furnace Creek Ranch, One Hundred and Seventy Feet Below Sea Level

By John L. Von Blon

DEATH Valley will have a "Garden of Allah." Furnace Creek Ranch, the solitary oasis of that high-walled, sun-blasted sinkhole, is being planted to dates. Despite its dread surroundings, possibly even because of them, it holds out bright promise as a future home of this sweet fruit of the Arab lands. Furnace Creek Ranch, one hundred and seventy feet below sea level, the lowest place where vegetation thrives and humans dwell, and the hottest spot on earth, thus becomes a place of special interest.

This date undertaking, which is not a venture but an enterprise, is already well under way and will surprise the world. It marks the extension of the industry in an unexpected direction and apparently opens large possibilities. In addition to transforming the main area, experiments are to be conducted at various outside points with the object of making parts of the quarter-million square miles of California and Nevada desert bloom and yield to gratify man's wants and needs.

AN OASIS IN THE DESERT

In the heart of the world's hottest and most desolate waste. Note the Washingtonia filifera *and* Phoenix canariensis *palms reflected here*

Water from Thermal Springs

Dr. Walter T. Swingle, noted explorer for the United States Department of Agriculture and principally responsible for the date industry in America, initiated the Death Valley plan after several years of close study. He is most enthusiastic over it, as, indeed, are other experts. Bruce Drummond, one of the foremost authorities and for seventeen years in active charge of the Government's successful date cultural work in the Coachella Valley, California, has been engaged permanently to direct operations at Furnace Creek, with headquarters at Death Valley Junction. He will reach far into the surrounding country, in both an active and an advisory capacity; and he will give his attention also to other fruits.

Furnace Creek Ranch is in the flat part of Death Valley and only a hundred miles distant from Mt. Whitney, continental America's loftiest peak, which stands 14,501 feet high; and from the cliffs nearby, glistening palms and eternal snows are visible on any clear day. In that atmosphere a hundred miles is as nothing to the eye.

The soil on the ranch is a dark, heavy, fertile, sandy loam. The holding has been operated for many years as an alfalfa proposition, with forty to fifty acres under cultivation. Originally, it was the headquarters of the famous twenty-mule teams that made possible the past and present achievements of the borax industry. Hay was then grown for these animals.

About two hundred tons of alfalfa are now produced annually and fed to a herd of high-grade beef cattle, supplying meat for the tables at the

TO SERVE EXPERIMENTAL PURPOSES

Four acres of seedlings have already been planted and are making a splendid and healthy growth. These seedlings are three years old

A SOURCE OF FUTURE REVENUE

First Deglet Noor palm on the ranch. This palm is three years old and is exceedingly thrifty. Its eleven offshoots are worth $220

mines in the mountains, some miles above, at a camp called Ryan. The tillable ground can be increased to one hundred acres; and it is all to be devoted to dates.

Water—and there is an abundance of it in the midst of this, the most appalling desolation on the globe—comes from thermal springs on the slope of the Funeral Range, and is brought down by pipe line. These springs are really the source and entire supply of Furnace Creek. Incidentally, the water is made to drive a little electric generating plant, an interesting sign of advancement in a primitive region that has seemed utterly unconquerable. The water is fine and clear, with a uniform temperature of seventy-four degrees, Fahrenheit; and the quantity is such that at present only the day flow is required for irrigation. The remainder runs off into the valley sump, two hundred and ninety-three feet below sea level, although evaporation and the sand claim most of it.

If, as the Arabs have it, "the date likes its head in the fire and its feet in the pool," the palms on Furnace Creek Ranch should be the happiest of their kind. The very air sizzles and seems almost ablaze, the dancing heat waves often resembling flocks of blackbirds not far away; and the mountain springs would fill many pools. Back of the old screen-porch ranch house a pool has been enclosed, a pool that is fascinating because of the general drab, arid, ghastly outlook in all directions.

Reflected in this pool are the tall, columnar trunks of half a dozen specimens of the California native "wild date palm," *Washingtonia filifera*, and the glossy fronds of a surrounding group of wide-spreading *Phoenix canariensis*. The latter is a native of the Canary Islands and therefore accustomed to a moist sea climate, yet the growth, health and beauty manifested by this particular specie of palm in this exceedingly dry atmosphere so far inland, are quite remarkable and have attracted notice. There is substantial evidence that palms rejoice here, for some of these trees are a quarter of a century old.

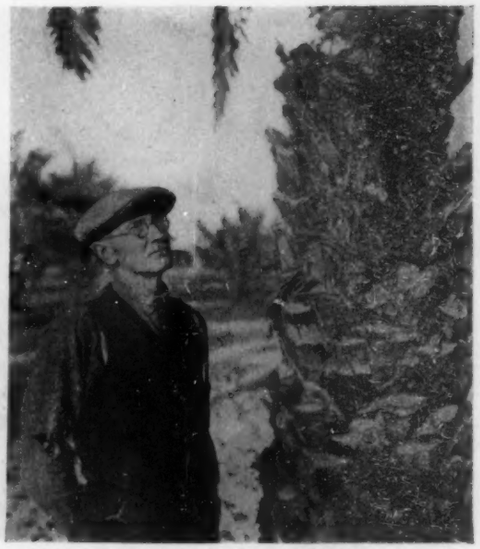
The primary idea at Furnace Creek Ranch is to turn out absolutely clean date nursery stock, without scale, insects or contamination of any kind, and thus help to supply the steadily increasing demand. It is believed that the major source of future revenue may lie in the sale of offshoots rather than in crop production; but the latter will not be curtailed further than is necessary to permit the strength of the palms to go to the trunks and foliage and provide nourishment so that both parents and offshoots will attain a size sufficient to withstand the severe shock of removal.

The whole industry's progress is dependent upon the number of such offshoots that can be taken and saved during the period between the fifth and fifteenth years. The average palm is good for fifteen to thirty offshoots, each of which is worth from fifteen dollars to twenty dollars. This estimate refers to standard imported stock.

Its Isolation an Advantage

Because of its isolated location on the bottom of a vast pit, hemmed in by many thousand square miles of forbidding desert, this unique ranch is the one place peculiarly adapted to the growing of stock which is perfectly free from pests of any sort whatever. Provided proper care is exercised, it will be impossible for pests to get in, the prospective growers declare. Every precaution is taken to exclude them, even to the extent that plantings are accepted only under positive guaranty.

Four acres of seedlings, propagated three years ago, have been set out and are making an excellent showing, serving well the experimental purpose for which they were intended. Now the imported varieties are being placed. First of these is a Deglet Noor, three years old, a handsome, luxuriant specimen with eleven offshoots that bespeak its money-bringing capability. It was selected by Dr. Swingle and provided by the Government, which is greatly interested in this new garden, more than two hundred miles, as the crow flies, from those of the Coachella Valley, the date center of the United States.



BRUCE DRUMMOND, AN AUTHORITY ON DATES

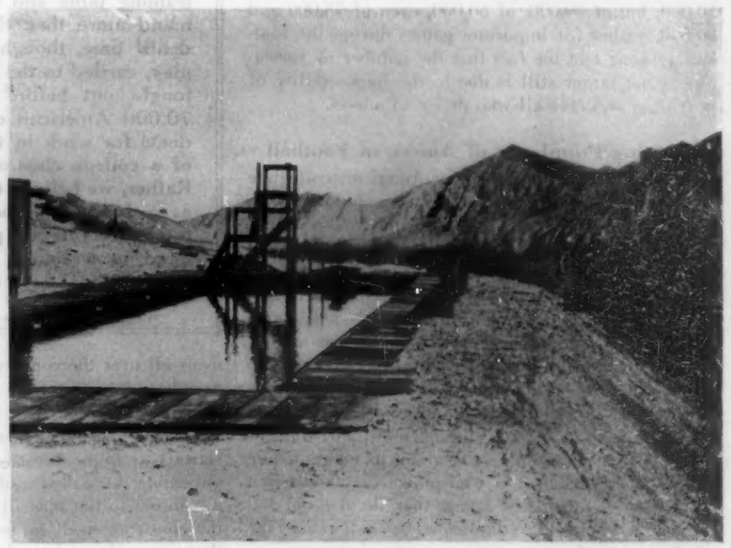
For seventeen years in charge of the Government's date cultural work in the Coachella Valley, now has charge of Furnace Creek Ranch

The Death Valley palms will be subjected to incredible heat; but they have already proved that heat agrees with them. The mercury climbs to 137 in the shade at Furnace Creek Ranch, and so much higher in the sun that no official record has been made. Few men have the hardihood to endure the hot season there, but always one or two may be found. The terrors of the region during those months cannot be exaggerated; but in winter and early spring it is a paradise, abloom with wild flowers and aflutter with butterflies.

The new development is based on the belief that the date industry holds the greatest promise in the world in California. In that State and in Arizona, all the dates this country produces are grown. There are 1,200 acres set out and 700 acres in bearing. The output last year was 600,000 pounds.

ONE OF THE FAMOUS TWENTY-MULE TEAMS

Hay was originally grown at Furnace Creek Ranch to feed the mule teams that made possible the borax industry



A WELCOME RETREAT FROM THE SOARING MERCURY

Where Death Valley picnics are held. The waters of Furnace Creek are piped into this pool just above the ranch

BUILDING THE CALIFORNIA MEMORIAL STADIUM

This huge structure, with a seating capacity of 78,000, is one of the largest in the country, and it is of particular interest because of the fact that its construction presented some unusual engineering problems. Hydraulic machinery was installed and jets of water under heavy pressure washed the earth from the sides to the floor of the canyon

New Arenas of Sport

Huge College Football Stadiums of Today Rival in Size and Seating Capacity the Ancient Coliseums of the Roman Empire

By Oscar Lewis

THE astonishing growth of popular interest in collegiate football during recent years has been one of the most remarkable developments in the history of American sport.

Fifteen or twenty years ago, 10,000 spectators was considered a remarkably large crowd to attend a football game. There were only a few athletic fields in the country capable of accommodating so many, and only a few contests, those between the chief colleges of the land, in which public interest was sufficient to fill even the comparatively small grandstands that then existed.

Again, contrast the relatively mild interest of that period with the state of affairs today. Crowds not of 10,000, but of 50,000, of 60,000, even of 75,000 and 80,000, gather for important games during the football season; and the fact that the number of spectators is not larger still is due to the impossibility of providing seats for all who desire to attend.

Amazing Popularity of American Football

It is easy to understand why American collegiate football has won this unprecedented popularity with the public. It is, with the possible exception of baseball, the most widely known and the most typical of our national games. Almost every schoolboy in the country has at some time or other played it, and is familiar with its fundamentals. It is a game in which keen thinking, quick judgment and agility count for more than mere physical strength, in which the co-operation of teamwork is vastly more important than individual "grandstand plays." Football, moreover, is one of the most thrilling of spectacles from the onlookers' point of view. There is a fascination about a well-played game between skilful, evenly matched teams that, in the opinion of many, cannot be duplicated elsewhere in the whole realm of sport.

The rapid growth of public enthusiasm for the game has brought about an interesting situation. Colleges all over the country presently found that their grandstands were totally inadequate to accommodate the crowds that wished to gain admission to every important game. Thousands of disappointed enthusiasts had to be turned away, and the committees governing the athletics of the colleges cast about for a solution to the difficulty. The one solution lay in the construction of larger playing fields. This task they presently undertook, and on a very large scale.

The college grandstand twenty to thirty years ago was a comparatively modest affair, both as to its size and its construction. Generally speaking, it extended down one or both sides of the football field, and rarely for its full length. The idea of extending the stands across the ends, thereby enclosing the whole area, as is done today, was not so much as thought of—this for the very good reason that, in those days, there was no demand for the large seating capacity that such an extension of the grandstand would have provided.

Some Stadiums Seat 80,000

The almost universal material of construction was wood, which was used for posts, sway-bracing, joists and the planking for risers and seats. The allotted space per spectator was by no means generous. The plank seats were narrow and so was the spacing. Hence it required some acrobatic ability to fit oneself into the conditions, and avoid overflowing one's neighbor or ramming one's knees into the back of the fellow in front!

But gradually we have changed all that. Wood has made way for steel and concrete; the individual spacing is more generous, so that one can sit in decent comfort; and the slope of the tiers of seats has been so carefully determined that one can be seated anywhere in a vast auditorium, containing nigh upon 100,000 souls, and be sure of a perfect view of the playing field.

The result of the growing interest in football has been the building of huge athletic stadiums, or "bowls," by dozens of colleges throughout the country. Having a size undreamed of a score of years ago, they are intended to be permanent settings for football games, and frequently for other athletic activities of the colleges. Their seating capacities range all the way from 40,000 to 80,000. Round or oval in shape, their huge tiers of seats are so arranged as to give every one of the vast number of spectators an unobstructed view.

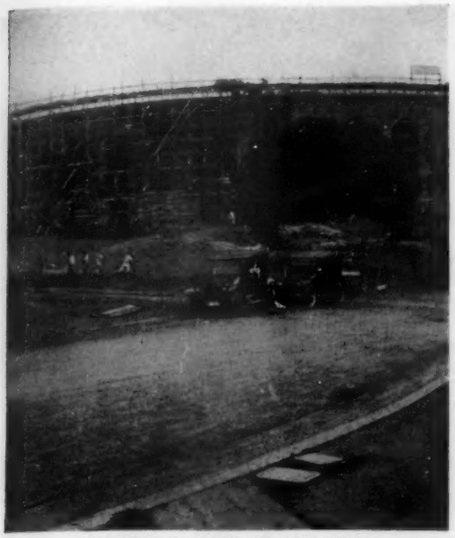
The building of such a stadium is, naturally, a very large undertaking. A million dollars will

Football and the Classroom

The rise of inter-college football to its present importance has taken place within a single generation. The present nation-wide interest is due to the growth in size of our colleges, the better financial condition of the students, the introduction of inter-college competition, and the enthusiasm of a sport-loving public which pays liberally to witness these great contests of brain and brawn.

Are our colleges giving too much attention to sport? Do the exactions of the training table and the practice field demand more than their share of the students' time, thought and energy? Does play, carried to the high point of a match fought out before a cheering mass of 70,000 American citizens, unfit the students for work in the unemotional quiet of a college classroom? We think not. Rather, we believe (and the writer speaks as a former football captain) that the total effect is to promote that "sound mind in a sound body," which is the supreme goal of a college course.

EDITOR.



EXTERIOR VIEW OF STADIUM

The outside wall, pierced with arches, is reminiscent of the Roman Coliseums

hardly cover the cost of one of these modern football fields. A typical work of this kind, the California Memorial Stadium, recently completed on the campus of the University of California, will give an idea of the magnitude and great cost of such undertakings.

The structure has a seating capacity of 78,000, making it one of the largest in the country. The building of the immense oval occupied more than a year and involved an expenditure of $1,250,000. Its construction presented some unusual engineering problems, due to the fact that the only site available on the campus was in Strawberry Canyon, a comparatively narrow area, walled in on each side by steep hills.

Now the difficulties of building a great structure like that proposed on such a site might well have seemed to be insuperable. There was no precedent to go upon. Hitherto, the large stadiums of this character had generally been built up in steel and concrete upon fairly level ground. In the case of the famous "bowl" at Yale, the vast oval was formed by "cut and fill"—the material being dug out from the center and banked up upon the sides until, at the completion of the job, the lower half of the sides was below the original ground level and the upper half was above the original surface.

In the case of the stadium in California, the engineers decided to cut away the sides of the canyon and deposit the excavated material in the bed of the valley where the latter debouched on the open and generally level ground. By finishing off the excavated sides of the valley at the desired slope for the tiers of seats, approximately one-half of the great amphitheatre would be provided; for the concrete seats could be laid upon the firm, undisturbed material of the hill itself. This was the method used by the Greeks and later by the Romans, in the construction of their theaters. A natural, curving hollow in the hillside was selected, the ground graded to the required slope and the marble seats, which may still be seen, were erected.

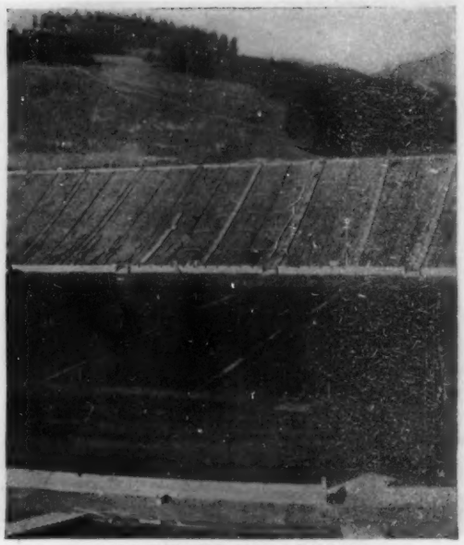
The Greek theater, however, was but a half-circle in plan, whereas this college stadium was to be a full oval. How was the other part of the structure to be formed?

Earth Removed by Hydraulic Streams

To accomplish this, the engineers adapted, with modern equipment, the methods used by the placer miners of early California days. A dam was thrown across Strawberry Creek, hydraulic machinery was installed, and jets of water under heavy pressure were trained on the hillside. With surprising rapidity the earth crumbled beneath the assault of the streams of water, was washed, dozens of cubic yards a minute, down toward the canyon's floor. This earth was, of course, not allowed to go to waste. The muddy streams were conveyed to the site of the stadium where they were allowed to flow into a temporary lake and deposit their soil and gravel. Thus, as the hill melted away, the surface of the future football field gradually ascended and took shape above the floor of the canyon. Within a few weeks, 280,000 cubic yards of earth were transported by this means, the water draining away and leaving a firm foundation for the field.

All this, however, was merely preliminary work. On this base of filled land the stadium itself was built. Its huge concrete walls were pierced by arches in a manner very similar to that of the Roman Coliseum, rising on the western or lower side to a height of 65 feet.

Inside, the completed structure with its acres of seats presents the appearance of a huge bowl, its sloping sides divided into forty-eight sections, each one of which contains seventy-two rows of seats. The great oval is carefully planned to insure rapid



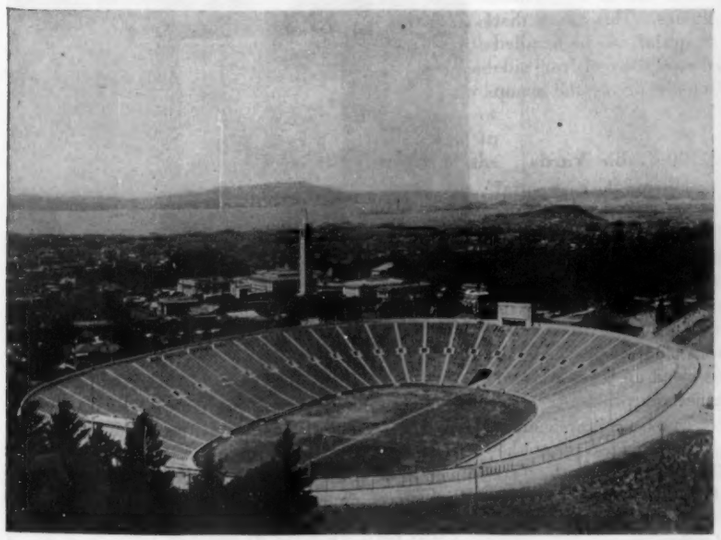
A SECTION OF THE STADIUM

Interior view, showing the building of the concrete seats upon the embankment

filling on the day of a game. Twenty-five subsurface entrances give access to the stadium, in addition to a like number opening from the runway on its eastern side, which is built against the base of the hill. With the help of the 300 student ushers required during important games, every one of the 78,000 reserved seats can be filled in less than an hour.

In the building of modern stadiums the playing fields themselves receive, naturally, the utmost care. Drainage, turf, atmospheric conditions, the location of the sun's rays in relation to the goal-posts, each detail receives the most careful attention. For it is on the field that the game is played. Upon this carefully prepared surface occur the thrilling contests, the matching of wit and skill and trained strategy, that has given football its hold on the American public, and that each season fills to their uttermost capacities the huge college stadiums of the country.

In conclusion, it is of interest to note that the famous Coliseum, whose majestic ruins are, perhaps, the most impressive sight in Rome, is credited by some authorities with the same seating capacity of 78,000 to 80,000 as the modern stadium of the University of California.

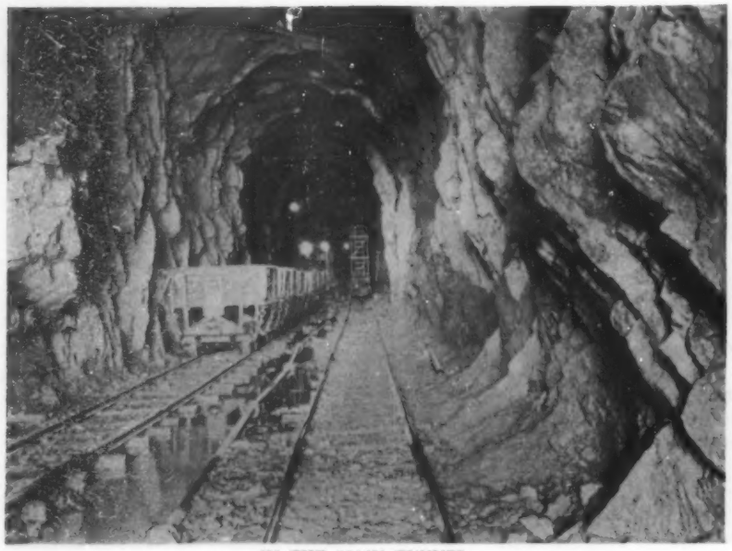


LOOKING DOWN UPON THE STADIUM

This great structure, built at the mouth of a valley, has a seating capacity of 78,000. Structure in foreground rests on excavated hillside; further portion carried upon concrete substructure

WASHING DOWN THE HILLSIDE

Hydraulic sluicing was employed to break up the rock and earth and fill in the canyon, thus forming the center playing field, which was then leveled and sodded



IN THE MAIN TUNNEL
The electrically operated work train on its light track

THE DRILL CARRIAGE USED
The pneumatic drill in its eight-foot by eight-foot heading

The Six-Mile Moffat Tunnel

By Means of Special Equipment the Main and Auxiliary Tunnels Are Being Driven Side by Side Through the Rockies

By George F. Paul

MODERN machinery is doing its full share in speeding up the work on the Moffat Tunnel which, six miles in length, is to pierce the Rocky Mountains to the west of Denver. Immense quantities of rock are to be moved in driving this tunnel. In reality there are two tunnels running parallel to one another.

THE AUXILIARY TUNNEL
To facilitate excavation this eight-foot-square tunnel is being driven parallel to the sixteen-foot by twenty-four-foot tunnel

The smaller tunnel, eight feet square, is later to be used to convey water from the west side of the Rockies to the east side. This pioneer bore is connected with the railroad tunnel by means of cross-cuts at intervals of 1,500 feet.

A special air-hoist has been devised for switching the muck cars. By means of the hoist, muck cars are picked up and switched laterally. This operation gets rid of all the delays and derailments that might otherwise be encountered. The operating cylinder is suspended from a little trolley that runs on a steel bar.

In order to save time in moving the drills at the headings, special carriages have been devised. A channel-bar frame supported on a track has a trolley with steel columns on each side; and these are held rigidly together by means of horizontal cross-bars. Screw jacks hold the bars against the side walls when drilling is being done. Within less than fifteen minutes after the time of arrival, breast drilling can be started. When the drill crew are working in one tunnel, the muckers can be at work in the other. Then they can shift places.

An apron, scoop and endless belt conveyor are features of the mucking machine. Four men are required to operate one of these machines. With this equipment they can load a car of fifty cubic feet capacity in about two minutes. This means that something like fifty tons of material can be handled in two hours. The apron and scoop swivel from side to side. A 50-horsepower motor drives the scoop deep into the muck pile.

Total Excavation 522,500 Cubic Yards

Faster progress has been made from the east portal than from the west. This difference is due to the fact that the crews working on the west section encountered much more difficult working conditions. Before the work started, geologists predicted that solid rock would be encountered at a penetration of about 1,500 feet. However, their predictions have not come true. The soft rock continues even at a depth of 6,000 feet. It has slowed up the work and has added greatly to the engineering problems.

The vastness of the project can be comprehended when it is considered that the estimates place the total rock excavation at 522,500 cubic yards. To handle this great volume of material, men working in eight-hour shifts are on the job day and night. Electricity for lighting and other purposes is generated at a station on South Boulder Creek. Direct current of 250 volts is supplied for driving the mucking machines, electric locomotives, blowers, et cetera. The air for the compressors is delivered to the headings by means of an eight-inch line that is carried through the water tunnel. Then smaller piping conveys the compressed air through the cross-cuts to the points where it is required. Fresh air is a prime essential for the men working at this altitude. A ventilating plant has been set up at each portal capable of delivering close to 25,000 feet of free air per minute to the various headings.

SWITCHING THE MUCK CARS
This air-hoist switch avoids delays. The muck cars are hoisted from the tracks and moved across on the transverse bar

Good working conditions for the men have done much to keep up their morale; good meals and good wages have done their share too. Having satisfied workers means much in a big project of this nature, where the work extends over a long period and where the ultimate success of the undertaking depends to a great degree on the loyalty of the men.

The Persian Lamb and Our Fur Industry

How the Crossing of Pure Imported Karakul Sheep with American Breeds of Sheep Will Make Possible the Production of Valuable Furs in the United States

By Guy E. Mitchell

FOR the furs of wild animals, used in producing my lady's coat at reasonable cost, the end is in plain sight; in fact it is already here. It is fortunate that furs are no longer a real necessity, for they are one of our most rapidly vanishing resources. Since the war the demand for furs has brought a good many people easy money and has somewhat changed our standards. This has resulted in the practical extinction of fur-bearing animals throughout large regions where they were formerly comparatively plentiful and where they were not hunted and trapped so persistently as to prevent reproduction. With this decrease in local production, the corners of the world are being searched for furs.

VERY YOUNG KARAKUL LAMB

The wool of the young lamb is soft and lustrous, and the curl is tight, uniform, and evenly distributed

What is the answer, then, with respect to furs? Just this, that sooner or later we will have to raise most of our fine furs just as we now raise beef where once people lived on deer or buffalo meat.

The recognition of this fact has stimulated a few of the far-sighted ones to breed an American flock of Karakul sheep from the lambs of which the famous Astrachan or Persian lamb fur is produced. This fur is now a great favorite; and garments made of it are successful competitors with the finest of fur coats made from the skins of wild animals. In fact these skins are classed by the trade and by the wearers as "real fur."

The production of this fur in the United States seems to be entirely feasible and should certainly prove commercially attractive. It is now imported mostly from Bokhara, in Central Asia, where there are reported to be some 3,000,000 or more Karakul sheep, from the three-day old lambs of which the fur is obtained. Curly, with a beautiful gloss, it is in strong demand for women's fur garments. Its increasing popularity has caused a steady advance in the price of these skins. Those of highest quality sell in New York for from eight dollars to twelve and a half dollars each; and even inferior skins bring three dollars apiece. This is no small price, especially when it is realized that the average is fifty or more skins to make an ordinary sized coat.

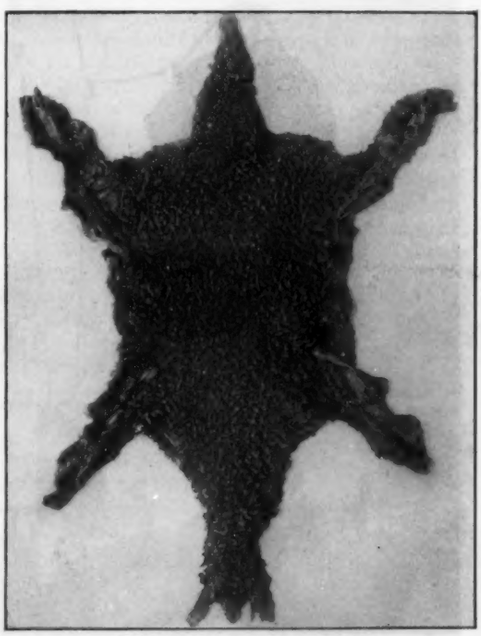
Karakul sheep thrive in the United States. This has been well demonstrated. The greatest difficulty in quickly establishing an American industry has been in securing importations of a sufficient number of pure-bred animals. There are now about 500 pedigreed sheep listed in the American Fur Sheep Registry. It is from these that an American Astrachan and Persian lamb fur industry must be built up.

This process would be exceedingly difficult and slow if it were not for the promise of cross-breeding. In this possibility—the crossing of pure Karakuls on American breeds of sheep—lies the future of the industry. It is to such experiments that the animal specialists of the Department of Agriculture and several private breeders are giving their attention. The results of some of these crosses are more than promising, it is stated by Government specialists; they are successes. Additional importations would be desirable, but they are practically prohibited by the strict quarantine of sheep on account of the dreaded foot-and-mouth disease to which sheep are subject. We must depend, therefore, on what we already have.

Keynote Must Be Breeding

Mr. Henry Hoffman, the registrar of the American Fur Sheep Registry, who has recently made a trip throughout the west and the northwest investigating the Karakul situation, says:

"There is a real future for Karakuls in America; but there is a lot of 'rubbish' being sold as Karakuls which do not produce fur, and this practise tends to injure the industry. Owners of questionable sheep are clamoring to be admitted to registry, but they have got to produce the goods. The American Fur Sheep Registry stands ready to register only sheep that can show a pedigree back to imported animals on all sides which have produced lambs with pelts of greater value as fur at the time of birth than the lamb at five months would be worth for meat."



CLASSED AS PERSIAN LAMB

The tight, even curl and fine luster are main factors in determining its value

While these pedigreed Karakuls are, of course, of the utmost importance as a foundation, for an Astrachan-Persian lamb fur industry, the great promise, as stated, lies in the assurance that American animal breeders will be able to cross these sheep with some of our well established American breeds, and that we may confidently look ahead a few years to seeing an American strain of Karakul that will produce lambs furnishing uniform furs of highest quality, possibly a much better product than the average of the furs now imported.

Immediate production, however, must not be expected—not until we have developed large flocks of Karakul sheep. The reason that greater progress has not been made during the last few years is that

IMPORTED KARAKUL RAM

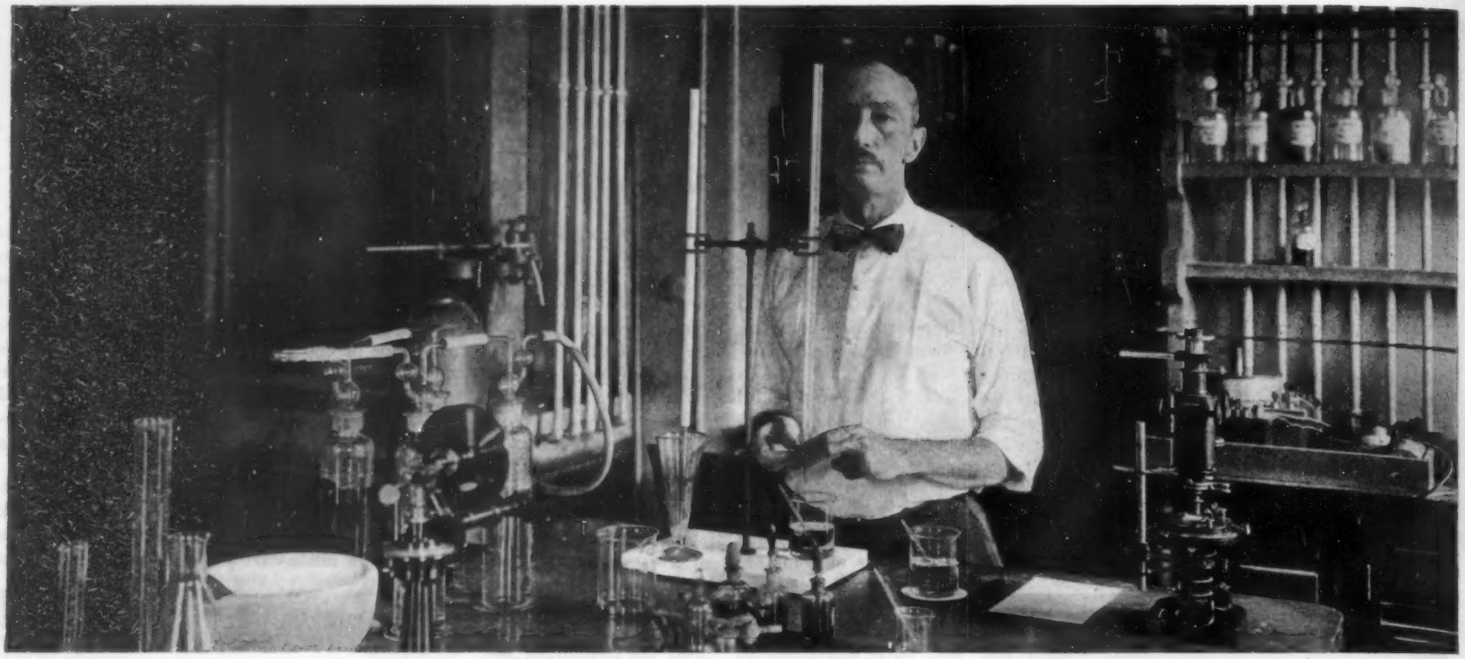
Note that the wool of the mature sheep is straight, wiry and almost white. It is of very little value

at least some American breeders have apparently been working with either too little capital or have not appreciated the possibilities of the industry. They have been trying to market skins instead of devoting themselves exclusively to increasing their flocks. The keynote must be breeding rather than killing for immediate profit the new-born lambs.

The furs known as "Persian lambskin," "Astrachan," "Moiree," and "Krimmer" are taken from the young Karakul lambs. These lambs are killed when from two to five days old, because the curl and gloss rapidly deteriorates with greater age. The skins of prematurely born lambs also have a value for fur; but the somewhat current idea that Persian lamb fur is derived from lambs removed from the ewes before the time of natural birth is erroneous.

Valuable as is the fur of the young lamb, soft, fine-haired and glossy-black, it appears curious that the wool of the mature sheep should be long, straight, wiry, and almost white; it is of the least value of that of almost any breed of sheep. The young lambs must be watched closely, however, like a quick-ripening fruit, for they must be killed at just the right day, almost hour. A delay of a day may loosen the curl of the fur or add to the thickness of the skin and thus halve the price of the pelt.

The Karakul is a heavy type of sheep, succeeding at a fairly high altitude and in a dry climate. Many of our western sheep ranges would, it is stated, furnish the exact requirements.



DR. TURRENTINE IN HIS WASHINGTON, D. C., LABORATORY

Goiter—A Dietary Problem

By J. W. Turrentine, Ph.D.

WHEN one makes the statement that the American Nation is goitrous, surprise and incredulity result, especially when the assertion is made to an American. Such a statement, however, not only is warranted by the facts but is particularly justified by the consideration that it may serve to arouse the American people to a realization of the true state of affairs pertaining to an important phase of public health. Certainly America is goitrous, to the extent at least that the majority of Americans are confronted by a distinct goiter menace.

Already a keen realization of this danger is being experienced by certain communities, as witness the State of Michigan inaugurating its newly enacted law requiring the addition of iodine to all salt sold for dietary use, and the City of Rochester, New York, dissolving iodine in the city reservoir, to enable—*to force* the people to acquire a more nearly adequate quantity of an essential element normally deficient in the diet.

Goiter Threatens the Mind

The aroused state of the public mind on this branch of public welfare has resulted from numerous medical surveys by federal, state and municipal health agencies to determine the incidence of goiter among the members of the communities chosen.

These surveys, for the most part, have concerned school children, possibly for reasons of convenience, and also because preventive measures are here more effective.

In most instances these surveys reveal an appalling state of affairs, showing as they do a large percentage of the school children already victims of incipient goiter and threatened with the dire sequence of mental and physical sub-normalities toward which that condition heads.

If the entire race had perpetual hay-fever, the symptoms would escape notice, being accepted as the natural order of things. In some communities the prevalence of goiter has reached this stage, particularly is this true in certain European localities.

Similarly, the concomitant mental deficiencies become merged in the general average, for the stupid child gets its share of parental affection and family care; and, after all, the chances are that its mental shortcomings are appraised by those suffering from the same lack of cerebral stimulation resulting from the same cause.

Goiter surveys now taken in many states from the Appalachians to the Pacific Ocean show incidences of as high as 75 percent in groups of schoolgirls of about 18 years of age and as high as 50 percent of entire school populations. Incidence being greater among girls than among boys, and particularly high among girls of adolescent age, the results vary with the bases on which surveys are made. It may be accepted, however, as a conservative estimate that 50 percent of the adolescent girls of the northern half of the United States, have incipient goiter.

HARVESTING KELP FROM THE SEA

Kelp is astonishingly rich in the kind of iodine which the body can assimilate as a goiter preventive

The cause of goiter is iodine deficiency. This fact is now established beyond a peradventure. Its cause is the absence and its prevention the presence of assimilable iodine in the diet. Goiter is generally taken to mean specifically an enlargement of the neck caused by the swelling of the thyroid glands there situated. It is, in fact, far more than that. It is a condition brought on by abnormally functioning thyroid glands, and manifests itself in a great many ways.

What These Glands Do

The substances secreted by the thyroid gland govern the growth of all cells. They promote metabolism and tend to prevent obesity. They act as a profound katabolic stimulant, facilitating the breaking down of exhausted cells and governing the elimination of the waste products of their disintegration. They exercise a protective antitoxic and immunizing action, defending the body not only against the toxic products of its own metabolism, but against invasion by disease-producing microorganisms and injury by their products. They are a potent aid in the recovery from disease. They are specifically associated in the exercise of their functions with the generative organs.

Is anything more needed to show the fundamental importance of maintaining the thyroid gland in a condition in which it can supply the body's full requirement of normal secretions?

Important among the substances present in these secretions is thyroxin, a complex organic compound containing iodine, for the manufacture of which the thyroid gland utilizes the iodine taken into the body as a natural constituent of food materials.

When the supplies of iodine are inadequate, the secretions are inadequate and the demands of the

various body functions go unanswered. As if in realization of its shortcomings, the gland undergoes compensatory hyperplasia, that is, it seems to feel that if it were larger it would be more efficient. It therefore grows in size and the swollen neck thus becomes the outward manifestation. When iodine is supplied, however, in a form assimilable by the gland, the situation is relieved, the secretions again become satisfactory, the demands become less insistent and the gland returns to its normal size.

But when this period of deficiency is prolonged, especially during the time when these secretions are needed for structural, sexual and mental development, as in youth and especially in adolescence, the results are irreparable, for without them the child is unable to metamorphose into the perfect adult.

Many Localities Lack Iodine

The sea is the world's great iodine reservoir. Iodine compounds for the most part being readily soluble, they have been leached from the rocks and soils of the earth's surface and carried into the sea. The rocks formed on the ocean's bottom and lifted up to become dry land carried small quantities of iodine dissolved in the sea brine with which they were originally saturated, but the rains of the succeeding ages have leached them out and deposited them again in the sea. The process, fortunately, is still going on, for in rivers and subterranean waters iodine is still to be found, but in quantities that are little more than traces. What has been leached from the soils of regions lying at higher altitudes, has been carried down, over and through the soils lying at the lower levels, leaving the soils at higher levels, more thoroughly leached than the lower.

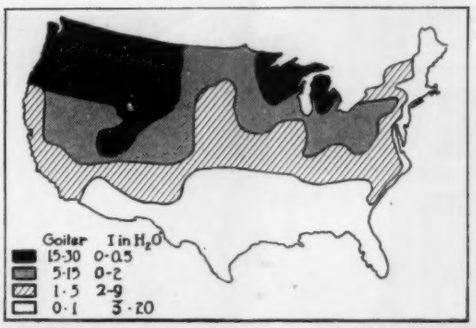
Analyses of the potable waters of the country show less and less iodine as the tops of drainage areas are approached, and, conversely, more and more as, following the direction of drainage, the sea is approached. Precisely the same is found to be the case with respect to goiter incidence, but in the reverse ratio. Goiter incidence increases as the tops of drainage areas are approached and as the iodine content of the drinking water decreases. But the iodine content of all soil water is so low that, it is obvious that the individual must obtain his iodine from food materials or artificial products and not from drinking water.

Soil water enters plants through their roots and evaporates from their leaves, leaving behind in the tissues of the plant any iodine which it carried. Thus, plants are found to contain small amounts of iodine, the amount being determined by the iodine in the waters of the soil in which they grow. Food products grown in inland regions of iodine scarcity

Courtesy "The Wisconsin Medical Journal"

CALLOID GOITER WITH MULTIPLE ADENOMAS

Age seventeen. The asymetric appearance of the enlargement demonstrates the presence of three groups of adenomas



WHEREVER IODINE IS DEFICIENT THERE IS GOITER

In one of these three goitrous areas—Michigan—the law requires that iodine be added to table salt

are much lower in iodine content than those grown on the coastal plains. There is, accordingly, a correlation between the iodine content of the foods grown in a given region and goiter incidence. To illustrate: in the wheat from inland regions there is to be found one milligram of iodine per ton; in dried apples, two milligrams; in oats (including the husks), 10 milligrams, and in spinach and stringbeans, both dehydrated, 18 and 29 milligrams, respectively. The growing child, it is authoritatively estimated, should have a daily supply of 0.1 milligram of iodine. To acquire its rightful share of iodine from such a diet, the child would have to eat daily, 200 pounds of wheat, or 100 pounds of dried apples, or 20 pounds of oats or 11 pounds of dry spinach, or seven pounds of dry string beans.

Animal products, with the exception of rich milk and butter, are no better, for the animal must rely for its iodine on the same inadequate sources as the human being; the same holds true for fresh-water fish.

Three Million Times as Rich as Wheat

Sea foods, on the other hand, are the only materials in general dietary use that contain anywhere near adequate quantities of this essential element, but, unfortunately, because of the high costs of preservation and transportation, they are unavailable for the vast majority of the population. Sea fish, such as blue-fish, contain 260 milligrams of iodine per ton, as contrasted with wheat containing one milligram, while oysters contain 1,160 milligrams per ton. The child fortunate enough to have provided for it a diet containing these delicacies would be able to acquire its essential tenth of a milligram if it ate one pound of blue-fish per day or one-fifth of a pound of oysters.

In the category of food materials, embracing land vegetables and meat products from both land and sea, no mention is made of sea vegetables, and here it happens is to be found iodine in truly phenomenal concentrations. Sea vegetables, by which we mean the marine algae, among Americans are practically unknown as articles of diet, although among the Japanese they are quite generally eaten.

The iodine content of marine algae, as compared with land plants, is astonishing. To illustrate: As compared with one milligram per ton in wheat, 10 milligrams in oats (including the husks), 18 milligrams in dehydrated spinach, 260 in blue-fish and 1,160 in oysters, one well-known species of marine alga contains 3,000,000 milligrams per ton! Thus the smallest "pinch"—to use a culinary term—of pulverized sea alga of the right sort contains more iodine than all the rest of the dinner and pantry supplies combined, and, being natural vegetable iodine, its use represents the immediate and complete solution of the iodine deficiency problem.

Sea vegetables, as they are harvested from the marine farm, have an odor and taste which are not stimulating to the appetite. They readily ferment and turn sour. When dried they are salty to the taste.

To render them available for general dietary use, sea algae, by methods now completely developed, may be processed to yield a flour, in appearance resembling graham flour, which can be added to the ordinary articles of diet in any way that is convenient. Since such small quantities are sufficient, its presence need not be detected. It may appear on the table as an invisible part of the dishes prepared in the kitchen, or it may come from the grocers as an ingredient of cereals or bakers' products, as bread for the family or as cakes for the child's lunch box. By its use the inadequate and debilitating wheat of the plateau regions may be given the vitalizing properties of the products of the sea.

The iodine-rich extract of these algae, prepared in tablet form, is now successfully employed by physicians and hospitals as a therapeutic agent for the treatment of goiter. Its great efficacy as a curative agent, even in advanced stages of that disease, is remarkable.

Thyroxin Potent in Life Processes

There is abundant evidence that the iodine of sea plants is comparable in nature to that of land plants. This conclusion, however, does not go far enough, for there is reason to believe that this iodine may be potent in its influence on the thyroid by virtue of the fact that it is a constituent of a definite chemical compound of peculiarly thyreotropic properties. In the complex compound, thyroxin, extracted from the substance of the thyroid gland, we have an example of an iodine-containing molecule that is very profound in its control of many life processes.

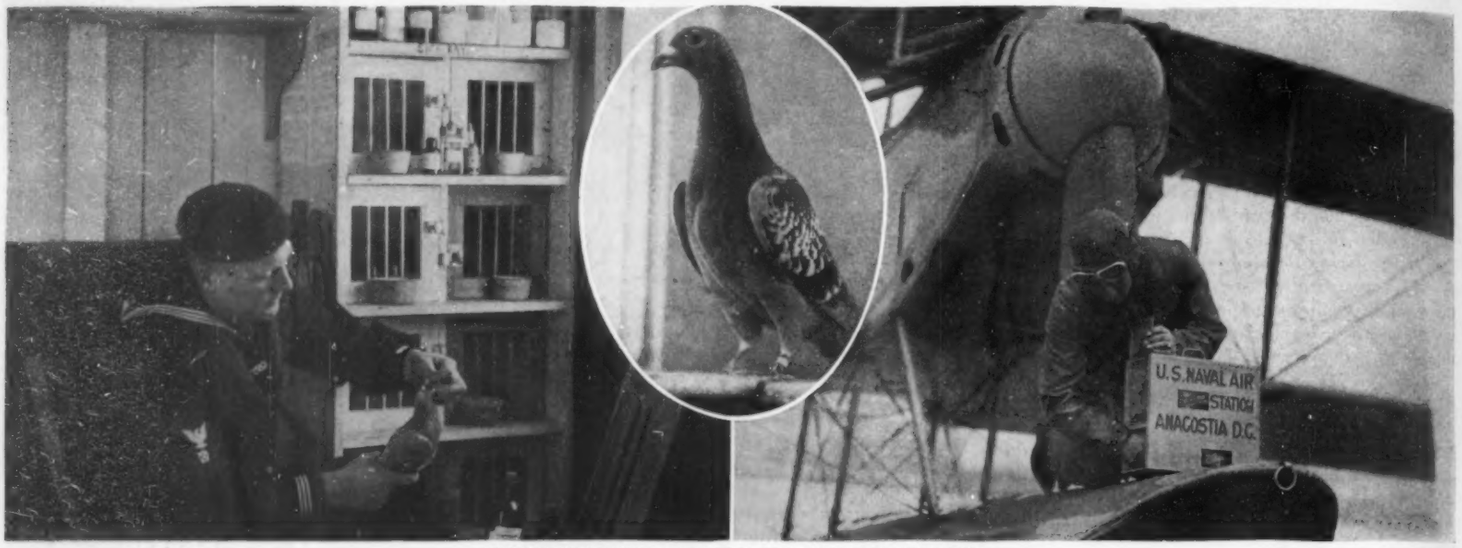
If there be present in these algae an iodine compound comparable to thyroxin in any important characteristic, it should be isolated in the pure state, its structure and properties determined and its synthesis attempted.

Marine algae are abundant and, being self-perpetuating, are inexhaustible. They may be harvested by sea-going reapers by the thousands of tons. Properly preserved and distributed they are capable of proving a boon to humanity. Their importance as an industrial raw material source for chemical iodine, potash, table salt, decolorizing carbons, plastics, sizing, stiffening and water proofing materials, acetone, oils and organic solvents, has been disclosed in recent researches. There is no use to which they can be applied, however, that compares in importance with their use as a source of vegetable iodine for human consumption. By their judicious use goiter among civilized races may be eradicated.

Courtesy "The Wisconsin Medical Journal"

THE SAME CONDITION IN A GIRL OF EIGHT

While iodine is not harmful, it is ineffective once such adenomas (gland tumors) as these have developed



HOW THE NAVY CARES FOR AND USES ITS PIGEONS

LEFT: *Pigeons require expert medical attention to keep them in the best physical condition. If a pigeon contracts a disease, it is isolated in this hospital or "sick bay" until pronounced cured.* RIGHT: *Homing pigeons are carried in a four-bird box divided into compartments. If a plane is disabled or forced down away from its base a pigeon is dispatched to report the trouble.* INSERT: *This typical Navy Homing Pigeon, besides winning races has demonstrated its utility for carrying messages*

Interest Revived in Racing Pigeons

THE sport of pigeon racing is fast spreading over the country under the fostering guidance of journals specializing in pigeon breeding. Associations are holding state and sectional meets at which attractive purses are offered to those who bring out the fastest birds. In this way we are discovering the strains which are best for breeding purposes. Pigeon racing is also very popular in Belgium, France and England. In olden times the pigeon was considered sacred in many oriental countries, and is yet so considered in a few localities. The Greeks used them to carry war messages, as did Brutus, the Roman officer.

The earliest record of their use in war dates back to 1574, when the Spanish were besieging Leyden. The Dutch were about to surrender, when a pigeon arrived with a message stating that help was coming! The besieged thereupon made a desperate effort and were able to hold out until reinforcements arrived. The French used them during the siege of Paris in 1870. During the early Indian Wars of America pigeons carrying messages were sent through lines held by the Red Men.

The racing and homing pigeons are quite different from the carrier pigeon. The first is beautifully formed, slender, graceful and bred to fly as swiftly as a locomotive, one having made a record flight of a mile and eighty-seven feet in one minute. These are not loft-free birds—that is, they cannot leave and return to the loft at will. The "homer" is quite another pigeon, beefy and large, bred for the table, while the carrier is an awkward, large bird with a peculiar wart-like growth on the nose and around the eyes. The last-named is bred for exhibition purposes, although it too has home-loving instincts and will fly long distances. The racer, as well as all of the fancy pigeons, is descended from the Wild Rock pigeon of Europe, of which the Antwerp and Liege types were the pioneers.

Some of the fastest racing homers are in the naval loft at Anacostia, D. C. In addition to carrying messages, the racers are used in the Air Service because they will fly higher than other types of birds.

Several methods are employed in sending messages. One is to attach a letter to the tail feathers of the bird. Another and much better way is to set the message up in large type, photograph it down and place the message in a tiny capsule which is attached to the body of the pigeon. When the bird reaches its destination, the capsule is opened and the message is magnified by photography.

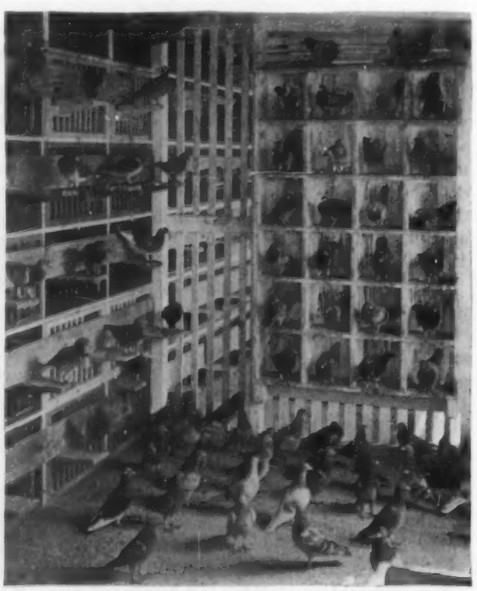
The racing pigeon is also used for the purpose of taking photographs. Neubronner, of Germany, invented a tiny camera which is used for this purpose. It takes about two dozen views and is less than two inches square, being made partly of aluminum with a weight of two and a half ounces. It has two lenses, working in two tiny cameras, one turned forward and the other backward. It works from every direction and is attached to the pigeon by bands and straps. A tiny rubber ball operates a small lever which is attached to the shutter. Air passing through the ball causes the lever to relax its hold on the shutter, and in this way the photograph is taken. With this camera attached to its body, the pigeon, circling over the surrounding country, takes numerous pictures.

Thus, pigeon breeding and racing combine both sport and service and are therefore sure to become well patronized throughout the country.

Courtesy of V. J. Pumpelly

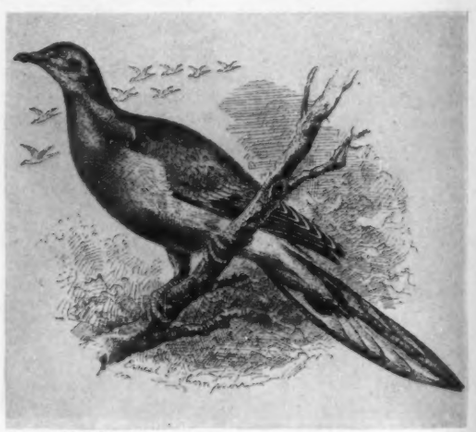
CLASSED AS A GRIZZLE

"Ziggie," above, is the Wisconsin champion. His progeny is now in California, Japan, Canada and many other places



INTERIOR OF PIGEON LOFT

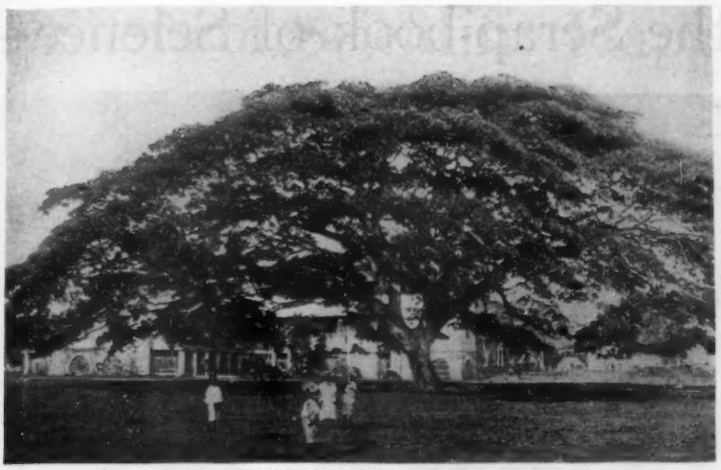
Like well-trained sailors these birds of the Anacostia loft stand as placed. A bathing fountain is part of the equipment



Courtesy of J. E. Reynolds

A SPECIE NOW EXTINCT

This passenger pigeon once was seen by the million in this country. Next to the frigate bird it was the fastest flyer



THIS MAGNIFICENT TREE IS NOT A MYTH

It is a saman tree, growing on the island of Trinidad, British West Indies. It is credited with water-transpiring powers, and goes popularly under the name of Peruvian Rain-Tree

THE MARVELOUS RAIN-TREE OF THE ISLAND OF FERRO

This old print, which appeared in E. T. Charton's "Voyageurs Anciens et Moderns," shows the tree in the full vigor of its activities. Note the natives collecting the water in jars

The Mythological Rain-Tree

Fifteenth-Century Travelers Told Tales of a Marvelous Rain-producing Tree

By Dr. Leon Augustus Hausman

Professor of Zoology, Rutgers University

THE rain-tree story, like the story of the sea-serpent, is ever with us. It will not down. According to the accounts, the rain-tree is a marvelous tree found in certain islands of the North Atlantic, in Peru, and in other parts of tropical South America, which sheds water copiously from its leaves—so copiously, in fact, that the ground beneath the tree is converted into a veritable bog from which brooklets run in every direction to water the thirsty neighboring territory! And not only can the tree produce its own rainstorm beneath its branches but, singularly enough, it can do so with much greater vigor and benefit in dry weather, when brooks are at their lowest and water scarcest! Serious reports have again and again advocated the culture of such trees in arid regions. Single trees have been estimated to produce as much as nine gallons of water per day.

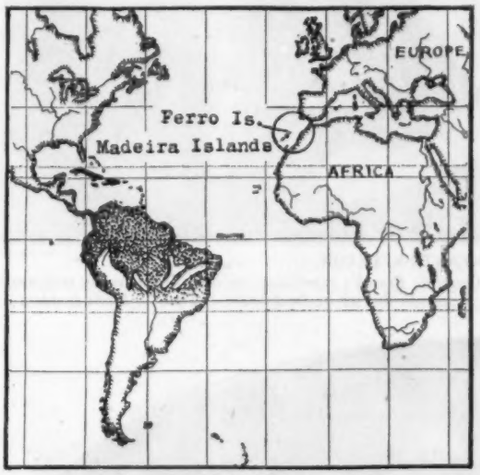
How the Story Started

How such a realistically detailed conception could have arisen is difficult to say. For, of course, the whole thing is a myth. There is no such tree as the rain-tree. And yet there are indications in the stories of early travelers and in the studies of modern naturalists which suggest the origin of the rain-tree legend.

Not until about the middle of the Fifteenth Century do we find the rain-tree definitely located. Accounts of voyagers at about that period locate it on the island of Ferro, near Madeira. This island is a high, rocky mass which rises from the water's edge, in some places as high as 5,000 feet. The whole island, says one account, depended for its moisture upon the rain shed from the branches of a single tree! No springs could be found upon the island, and no rain from the clouds was ever known to fall there. In 1863, the story was still in full enjoyment of general credence, and was incorporated in E. T. Charton's fascinating *Voyageurs Anciens et Moderns*, published in Paris in that year.

Next, the story was attached to a certain tree in tropical South America, the well-known saman tree. The saman tree is not a myth. It is a huge and beautiful tree, rooting deeply, and sending up a stout trunk bearing a crown of leaves that is truly a marvel. In some saman trees this crown stretches out so as to cover more than half an acre of ground. But, as if this were not enough to distinguish and ennoble the tree, legend must accredit it with the miraculous power of rain-producing.

Because it was found abundantly in Peru, the saman tree goes under the name of the Peruvian Rain-Tree. It is also called the giant Thibet tree,



WHERE THE "RAIN-TREES" GROW

The Peruvian Rain-Tree, or saman, is found all over tropical America, and on the nearby islands

South American acacia, zamang, and genisaro. Botanists know it under the name of *Pithecolobium saman*, the generic name meaning monkey ear, and referring to the shape of the large curved pods. We know much concerning the saman tree, for here we are dealing with a real tree, and not—as was the case with the Ferro rain-tree—with a mythical vegetable. Yet we know nothing (except by hearsay) of its wonderful water-transpiring powers. And these powers would be quite the reverse of what we should expect a normal vegetable to exhibit. It is true, of course, that leaves of trees and plants in general do transpire some moisture, frequently—in some forms—enough so that globules of water roll down from the leaves. But this never happens in dry weather or in a dry territory, and never enough to produce anything like a shower.

With regard to the story of the Ferro rain-tree it seems reasonable to suppose that sailors had noticed that there were no springs on the island, and furthermore that the trees on the uplands were dripping with moisture. This latter phenomenon can be seen by anyone today. The explanation is that while no rain falls on the island, yet the uplands are frequently buried in dense fogs, which condense their moisture on all they bathe, particularly on the leaves of the trees. Thus, and not otherwise, is the island supplied with water. This seems but an unsubstantial basis for such a tale as that of the rain-tree; but it seems the only one we can find.

A Celebrated Botanist Explains

Now, with regard to the rain-giving qualities of the saman tree. First, let us note that no one has seen a shower of rain going on under the branches of this tree—at least no one who reported it afterwards. And now, for a record of an observer about whose powers of observation and recording there can be little question, the celebrated English botanist and traveler, Dr. Spruce. He says, writing of his experience in September, 1855; in Moyabamba, Northern Peru:

"I had gone out one morning at daybreak with two assistants into the adjacent wooded hills, to botanize. A little after seven o'clock we came under a lowish spreading tree (the saman tree) from which, with a perfectly clear sky, a smart rain was falling. A glance upward showed me a multitude of cicadas (we term them popularly, locusts) sucking the juices of the tender young branches and leaves, and squirting forth slender streams of limpid fluid.

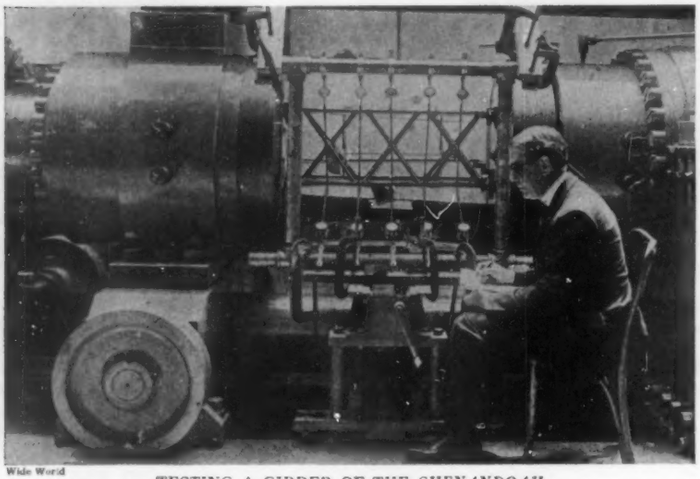
"Those who have noted the copious discharges of fluid from the aphids which sometimes infest our city shade trees will have no difficulty in conceiving of this phenomenon. It seems very probable that this phenomenon, seen by those who allowed it to lose nothing in the recounting of it, accounts for the stories of the rain storms which descend from the leaves of the saman tree."

From the Scrap-book of Science—Camer

Keystone View Co.

A NEW MASK FOR PACE MAKERS

Leon Lauthier, motor-cycle pace maker, while setting the pace to Brunier in his new bicycle speed record, wore this mask. A tube, opening behind, enabled the pace maker to coach the cyclist



Wide World

TESTING A GIRDER OF THE *SHENANDOAH*

A scientist at the U. S. Bureau of Standards subjecting the girder to a slowly increasing compressive stress. The deformations of its various members are read on five dials. This testing machine can exert a force of hundreds of tons—or crack an egg!

Pacific & Atlantic

HOW X RAYS ARE BROUGHT TO T

Patients who cannot be removed to a hospital are X-rayed the car reaches the tube via flexible wires, the wire is The car contains a dark room for developing t

CARTHAGINIAN INFANT SKELETON

On the Algerian site of ancient Carthage, destroyed by Rome, Count de Prorok's expedition has been finding many evidences of a vanished civilization. Here is a baby's skeleton found in an urn dug up at the Temple of Tanic, a Punic goddess

Pacific & Atlantic

FINDING "THE ST WORL

Scientists of the Smithsonian Institution, at Washington, D. C., are actually rec an extinct reptile found by Prof. Charles W. Gilmore, the west.

Wide World

LIQUID LENS LAMP

The lamp, having a concave or dented end (note lamp held in man's hand), is immersed in a container filled with liquid. The concavity forms a condensing lens and throws a beam of light without the usual heat. It will be used for projecting moving pictures and for other purposes

Keystone View Co.

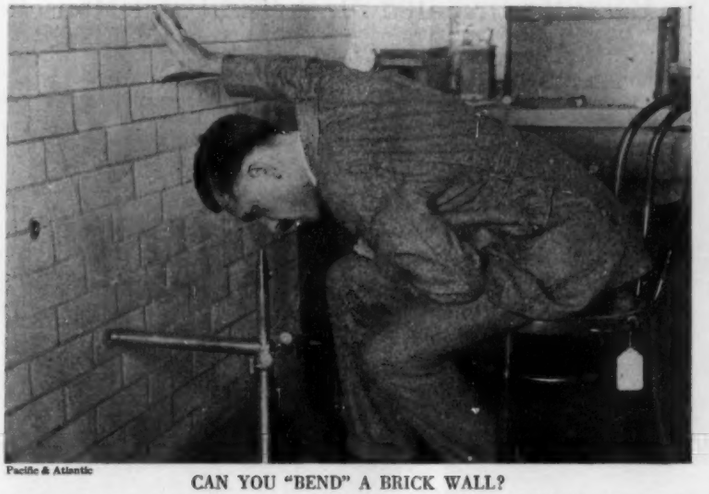
A NEW YORK SHERLOCK HOLMES

Edward J. Kelley, Jr., in charge of the laboratory of the Bureau of Criminal Science, which will analyze criminal suspects for the New York Police Department

-Camera Shots of Scientific Happenings

S ARE ROCKET TO THE HOME

o a hospitalare X-rayed at home. Power generated in ble wires, the wire is for a telephone to the bedside. rk room forkeeloping the film immediately



Pacific & Atlantic

CAN YOU "BEND" A BRICK WALL?

An instrument, by means of which the minute deflexion of a 40-inch brick wall may be measured when you press it with your hand, has been perfected by the U. S. Bureau of Standards. The scientist is observing the tiny movements through an eyepiece

Wide World

LIGHT WITHOUT SHADOWS

Surgical and other work is hampered by shadows. A lamp with a cylindrical prism sends its rays to the silvered reflectors. They focus on the work from many angles. Hence, no shadows

IG "THE EST WORLD"

D. C., ar ually reconstructing the fossil skeleton of an eighty-foot dinosaur, Gilmor the west. The dinosaurs had more brawn than brain.

Pacific & Atlantic

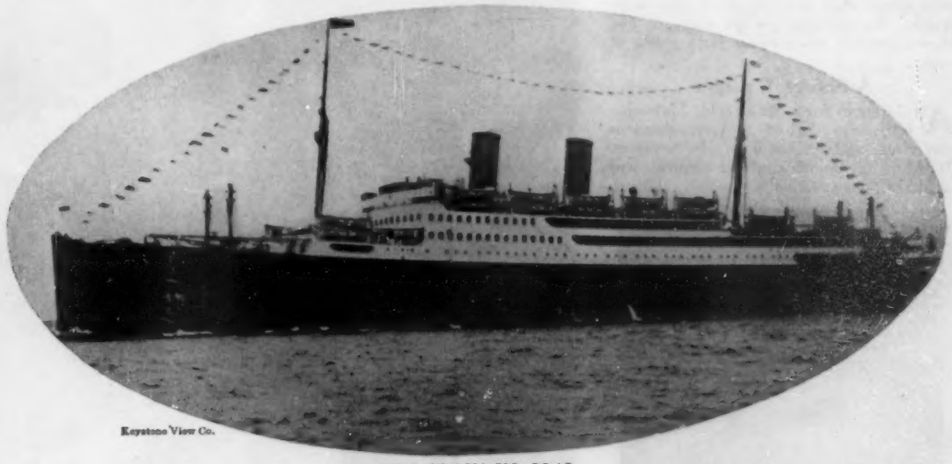
ONE ACRE EQUALS THREE ACRES

At Daytona Beach, Florida, strawberries are being grown on the vertical plan, from the sides of stacked-up crates. This saves space, keeps the berries free from grit and gives the winter crop more sunshine. Growers say this plan has made good

Pacific & Atlantic

FORGERY OF FINGERPRINTS CLAIMED POSSIBLE

Milton Carlson, fingerprint expert, is shown here with a knife bearing alleged forged fingerprints of a man who has been dead six years. The knife is of recent manufacture



Keystone View Co.

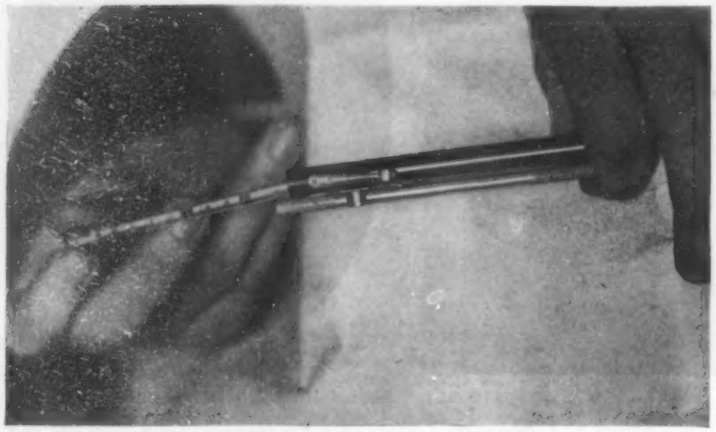
SHIP BURNS NO COAL

Driven solely by Diesel engines that consume low-grade oil, the new Swedish liner Gripsholm *recently made her maiden trip to New York. She is 575 feet long, displaces 23,500 tons and carriers 1617 passengers. Her speed averages 20.4 miles per hour. The funnels are dummies*

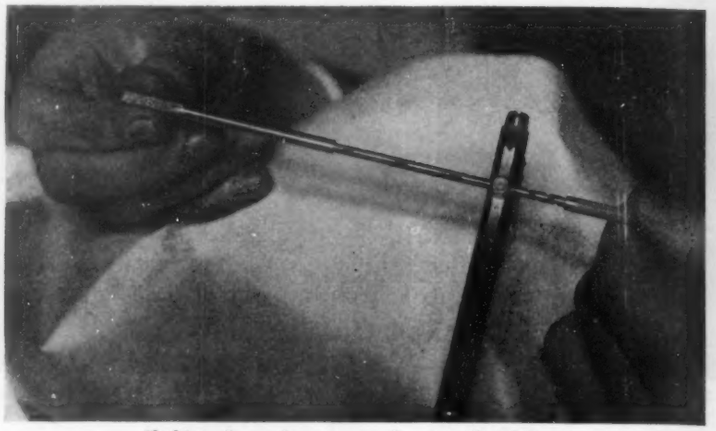
Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins



Taking the thermometer out of the whirling case



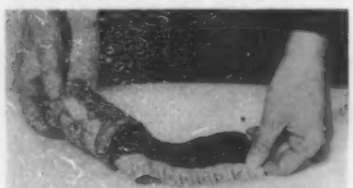
Shaking down the mercury by centrifugal force

Thermometer for the Pocket

THE thermometer holder illustrated fits neatly into the vest pocket like a fountain pen. Instead of shaking the mercury in the thermometer down by hand (that is, instead of giving it several hard shakes) you simply pull on the two little rods shown. These are provided with threads like an automatic screw-driver, and spin the thermometer case around the shaft, shaking the mercury down to the bottom by centrifugal force. By pushing on the rods, they are closed up, and can then be closed along the side of the thermometer case.

You Cannot Spill This Blueing

BLUEING on a paper tape, as shown in the above illustration, will not spill. Neither will it freeze in the laundry some cold winter night and best of all there is no waste. The printing on the strip of tape shows just how much to use for a gallon of water.



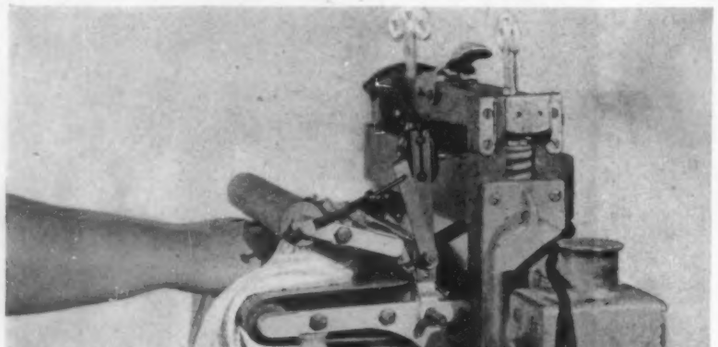
Blueing by tape

A Safety Wringer

AN inventor from Springfield, Massachusetts, has devised a very ingenious safety feed and automatic stop for wringers. Wringers are prolific cause of accident, particularly where driven by power. Electrically operated wringers are now coming into quite general use. They are much used in combination with electric washing machines. It has been estimated that washing machines are now being fabricated by two hundred and thirty manufacturing concerns.

One of the illustrations shows an operator feeding clothes into the mechanism which carries them to the wringer rolls. The other illustration shows the operation of the safety device. If the operator's hand becomes tangled with the clothes which have been drawn into the wringer, the top roller and frame (being pivoted at the inner edge of the lower frame), will cause it to rise and push a horizontal, hinge-like, push rod that will in turn press a button on the automatic switch, thereby shutting off the motor before the operator's hand reaches the wringer rollers where the damage is done.

The device can easily be taken off one side of the wringer and shifted to the other side if wanted. Rubber screws keep the clothes from sticking to and winding around the wringer rollers.



Detail of the wringer stop, showing safety switch

Radiator cap is secured from inside

If the hand is caught, the wringer stops automatically

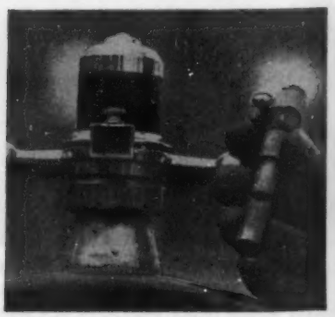
Cleaning Carpets on Concrete

THE plant for the Hoboken District of the Pullman Company has a new concrete carpet platform, or rack, that is equipped with compressed air and vacuum through a syphon jet. This feature—the last word in cleaning—completes the carpet cleaning installation in the new yard. With this equipment the conditioning of cars can be carried on expeditiously and in a cleanly and satisfactory manner. The extremely cleanly condition of our parlor and sleeping cars is not attained without great labor and the most ingenious contrivances are used in the car itself to ensure sanitation.

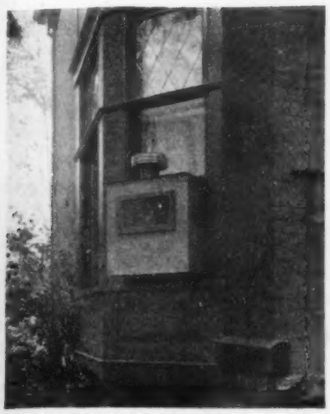
Cleaning the Pullman carpets

Novel Radiator Cap and Alarm

THIS radiator cap illustrated is novel in three ways. First, it has a good appearance. Second, it is burglar proof. It is attached with a special wrench from the inside and cannot be taken off the car from the outside. Third, it has a novel whistle which is attached to the overflow pipe on the radiator. When the water and the motor get warm, this whistle will blow and warn of the danger and trouble ahead.



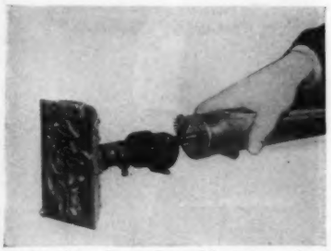
Whistles when everything gets warm



This little kitchen is entirely in the open air, thus doing away with odors

Putting the Kitchenette Out the Window

IT is said that more than twenty million women in America swelter over cook stoves three times daily. That this is unnecessary torture is the claim of the inventors of a new type of stove, called the "save a room cookitchen." It is said that this stove actually saves a room, because it is built in a window or in a wall. The fumes from cooking pass outside. The invention is a sanitary and labor-saving one and offers maximum convenience and comfort to the housewife. It saves steps and the dread of hot days over a stove. The little kitchen is wired and lighted. It is made of metal and the panel over the doors inside the room is embossed to harmonize with interior furnishings. One type, a portable window kitchen, is especially built for light-housekeeping apartments and for homes where gas, vapor, or electric plates are used. To install it, it is only necessary to raise the window, pass the kitchen through and screw it to the side casings. By closing the doors of this kitchen, the room can be kept cool during hot days.

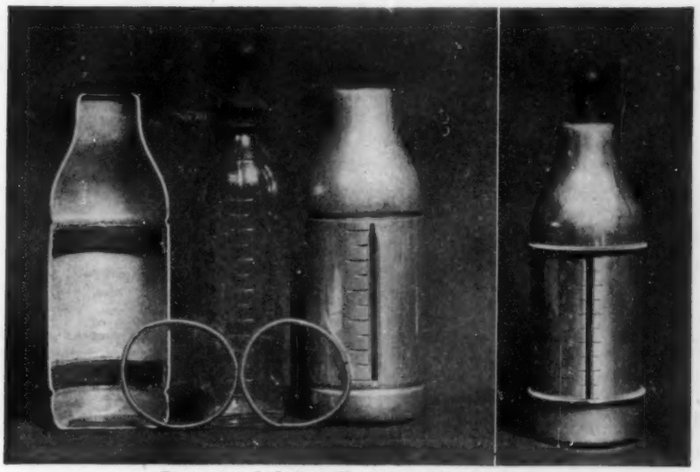


Combined torch, soldering and branding iron

Blowtorch and Branding Iron Combined

AN interesting blowtorch and branding iron is illustrated on this page. It is used to brand trademarks and to brand the name of the owner on tools in construction work. The brands are all interchangeable and fit on the end of the gasoline torch as shown. A single burner torch burns from one and one-half to four hours without refilling.

Saving the old blades



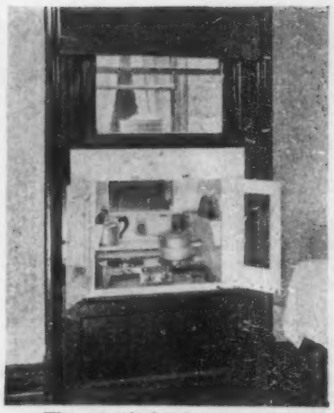
Protecting baby's milk with rubber buffers

Baby Bottle Protector

THIS baby-bottle protector is made of light weight aluminum in two fitted sections. It completely encases the bottle with several buffer strips of pure live rubber inside, to protect the bottle from jars and knocks when accidentally dropped upon the floor or any hard surface. The two sections are held together by two spiral coil springs easily slipped on or taken off. Breakage of the bottle is thus prevented, protecting the baby from broken glass. Since the bottle, thus protected, cannot be broken nor the nipple separated from the bottle, the device insures against loss of milk at inconvenient and embarrassing moments. It precludes the soiling of bedding, carriage covers, clothing and prevents the soiling of rugs, furniture or other things about the house. It helps maintain the heat of the baby's food for sometime, thereby making it ideal for traveling. It is sanitary and easily cleaned.

Safety hydrant prevents damage when sheared off

Doing away with carbon paper by substituting a ribbon



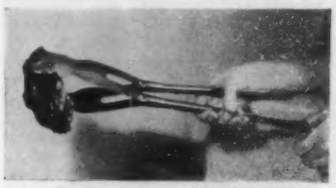
The outside kitchen exposed

Preventing Floods When the Hydrant Breaks

THE hydrant shown in our illustration is so constructed that it will not flood the street or damage property if, by accident, the standpipe is broken off or cracked. No water can enter the standpipe until the hydrant is operated by turning the main spindle.

Tongs With a Novel Twist

THE peculiar motion of the pair of tongs shown on this page is most fascinating and must be seen to be appreciated. They pick up anything and are especially useful where there is an open fire. They save the hands in many ways.



Tongs that save the hands

A Government Employe Saves Carbon Paper

THE Government was grateful to the extent of three hundred dollars to A. Eugene Melton, who invented a device for a typewriter which eliminates the necessity for carbon paper. In his invention, a ribbon takes the place of the carbon. The picture shows how the ribbon runs between three sheets of paper.

Razor Blade Stroppers

HERE are two razor blade stroppers which have special points of merit. Old blades which can be put into good cutting condition with but little effort should be saved.

With these stroppers, ordinary leather straps are used. A special guard prevents the edge of the blade from being rounded by careless stropping at the wrong angle. When through shaving, replace the blade in the stropper, dry it quickly on your clothing and leave it there until the next shave, without danger of cutting the towels.

Another stropper for safety razor blades

Golf grip in the left hand

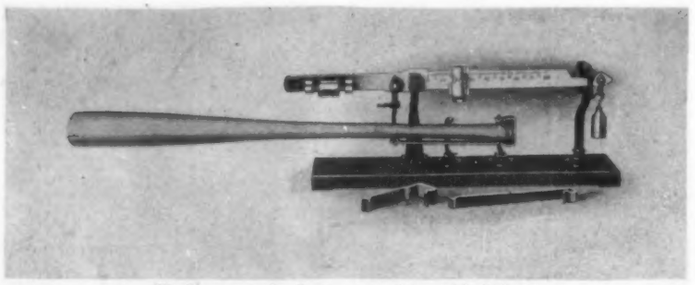
A Positive Grip for the Golf Club

VARIOUS devices have recently been introduced for enlarging the end of the shaft of a golf club in order to overcome the pull of centrifugal force. They usually taper away from the hand and the increase of size is the same all around the shaft. This means that the resistance and brace against the centrifugal drag is not sudden and positive enough, and worse still, that the swell of the big end comes onto the bulge of the muscle on the little finger side of the left hand, which throws the shaft out of the natural alinement it has with the normal finger grip. Needless to say, in a game that calls for such mechanical accuracy as golf does, one cannot afford to handicap oneself in this manner. Many of the great golfers thoroughly approve of the principle embodied in this invention. The illustrations show the position of the grip on the shaft.

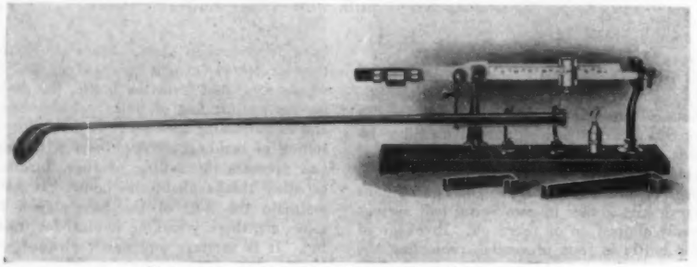
A new type of children's vehicle

Scales for Determining "Heft" or Balance in Handles

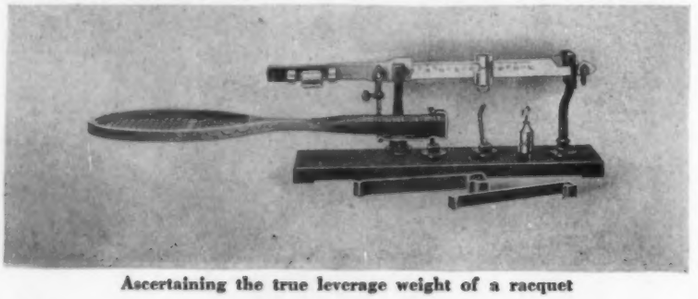
IN the clever scale designed by Mr. P. A. Vaile, the well-known writer on golf and tennis, each implement of sport is gripped in a special holder and the end of the holder is inserted beneath a hook attached to the base of the scale. The other end of the holder, representing an arbitrarily fixed fulcrum, rests in a hook attached to the scale beam. By this means it is possible to determine with accuracy what we will call the "constant" of the clubs, indicated by the setting of the poise on the beam. Our "constant" of the club is therefore a product of weight multiplied by inches. Let us therefore choose the measure of weight as the pound and the measure of distance as the inch. It is then easily within the scale-maker's art to graduate the beam of the scale so that the "constant" will be inch-pounds, which is a term defined in all text books on physics or engineering. Now we know something definite about that quality of the club which has heretofore been vaguely referred to as the "balance," the "hang" or the "heft" of the club. If it be desired to duplicate a club the constant of which was known, it is a simple matter to check the replacement club in this scale and then either load or trim as required.



Finding out the leverage weight of ball bats



Doing away with "feel" and "heft" by scales

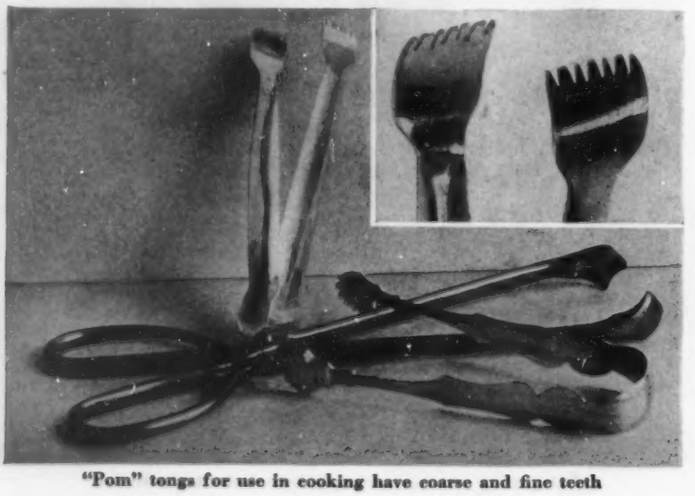


Ascertaining the true leverage weight of a racquet

A New Form of Joy Ride for the Children

A NEW type of children's vehicle has been developed from what is known as the "kick-sledge," a means of travel well-known in Scandinavia. This was merely a chair on long runners. A Swedish engineer has transformed this idea into a toy for children. A child standing with a foot on one of the foot rests in the rear and grasping the wide handles in the front gives a long shove with the free foot and thus starts the vehicle moving.

Expanding the collapsible cart



"Pom" tongs for use in cooking have coarse and fine teeth

Grip at top of the swing

A German Cart That Folds Up

ONE of our German correspondents sends us a couple of pictures of a collapsible cart which folds up into very small compass. The left-hand illustration shows the folding mechanism of the bottom of the cart. First the wooden bottom is folded against the sides, then the framework is folded up. The folded cart is shown in the illustration at the bottom of this column.

A Novel Form of Household Tongs

A SHORT time ago a lady brought into our office an extremely clever pair of tongs with alternating sharp and dull teeth. With this pair of tongs an effective gripping action may be had without danger of the short teeth projecting through the article with which the device is engaged. The new tongs are very useful in the kitchen. We illustrate the tongs upright with an enlarged view of the teeth. In the foreground is a large pair of brass lazy-tongs and lying on it is a pair of silver sugar tongs, both dating from the early part of the nineteenth century. This group shows most admirably the progress of invention, from the purely decorative sugar tongs to the very useful tongs with the alternate teeth.

A toy inspired by the kick-sledge

How the cart is folded

The Scientific American Digest

Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

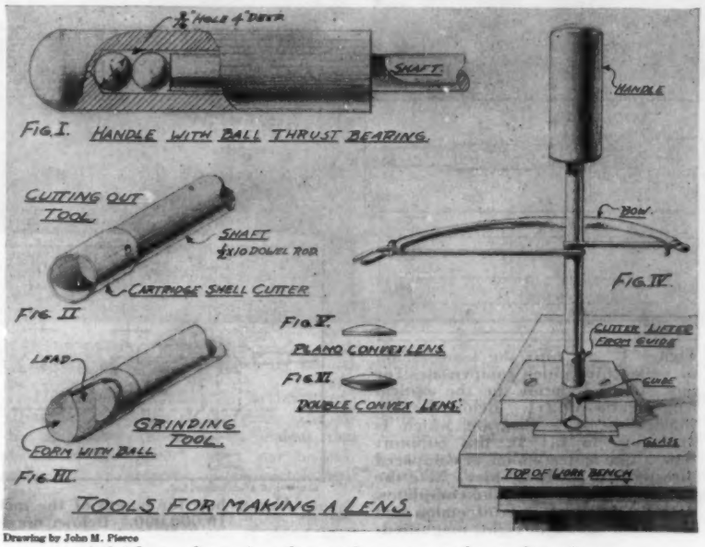
A Small Reflecting Telescope

To those who feel that the construction of the telescopes described in the February and March issues of the Scientific American, and in the book, "Amateur Telescope Making," (Scientific American Publishing Company, New York) is beyond their skill or patience, a small, simplified instrument having a spheroidal mirror four inches in diameter is described by John M. Pierce, of the "Telescope Makers of Springfield." It may, moreover, prove to be a stepping stone to the construction of a larger instrument.

The speculum or concave mirror was made from a piece of automobile wind shield one-quarter of an inch thick. This was ground and polished to a focal length of 24 inches, following substantially the directions given in the February, 1926, issue of the Scientific American, except that no attempt was made to parabolize its surface. The latter simplifies the glass work, and while a spheroidal curve is only an approximation to the paraboloidal curve, which is perfect, it was found on trial to give satisfactory results. The rings of Saturn and the bands and satellites of Jupiter appeared beautifully clear and distinct. It also proved to be a powerful terrestrial telescope. If any improvement were to be suggested it might be the use of a thicker disk of polished, commercial plate glass, since assurance cannot be given that a thinner one will retain its figure and will not warp out of shape.

The speculum is held on a hexagonal wooden back by three screws, fitted with fiber faucet washers, which press it down upon three cushions, made by cutting ½-inch thick slices from a rubber sponge. Unless ½-inch glass has been used for the speculum the screws must not be tightened much, as this distorts thinner glass.

The diagonal mirror is made from a piece of ¼-inch plate glass and measures 1 x 1¾ inches. The ends are ground to a bevel by rubbing them upon a flat glass or iron surface with a medium grade of carborundum and water. They may be left square if desired. The diagonal mirror is silvered on its front face, following the directions given in "Amateur Telescope Making." The silver may be protected, like that of the speculum, with a thin coat of lacquer. Set this mirror at exactly 45 degrees and directly over the eyepiece hole. The center of the diagonal should be at exactly the same distance from the bar as the center of the speculum.



Drawing by John M. Pierce

A fairly good eyepiece for a telescope may be made at home

The eyepiece is made by removing one flange from a spool, enlarging the hole, and mounting a magnifying glass in it. A lens of about one inch focal length is most satisfactory. It may be held in the spool by imbedding it in chewing gum. A lens of shorter focal length will give a greater magnification; one of greater focal length, a greater field with less enlargement.

Lenses suitable for this purpose or for use as magnifying glasses can be made quite easily and accurately with very simple tools. The best lenses are made from optical glass. A broken spectacle glass will provide excellent material. Ordinary plate glass from a broken mirror or automobile wind shield will be satisfactory.

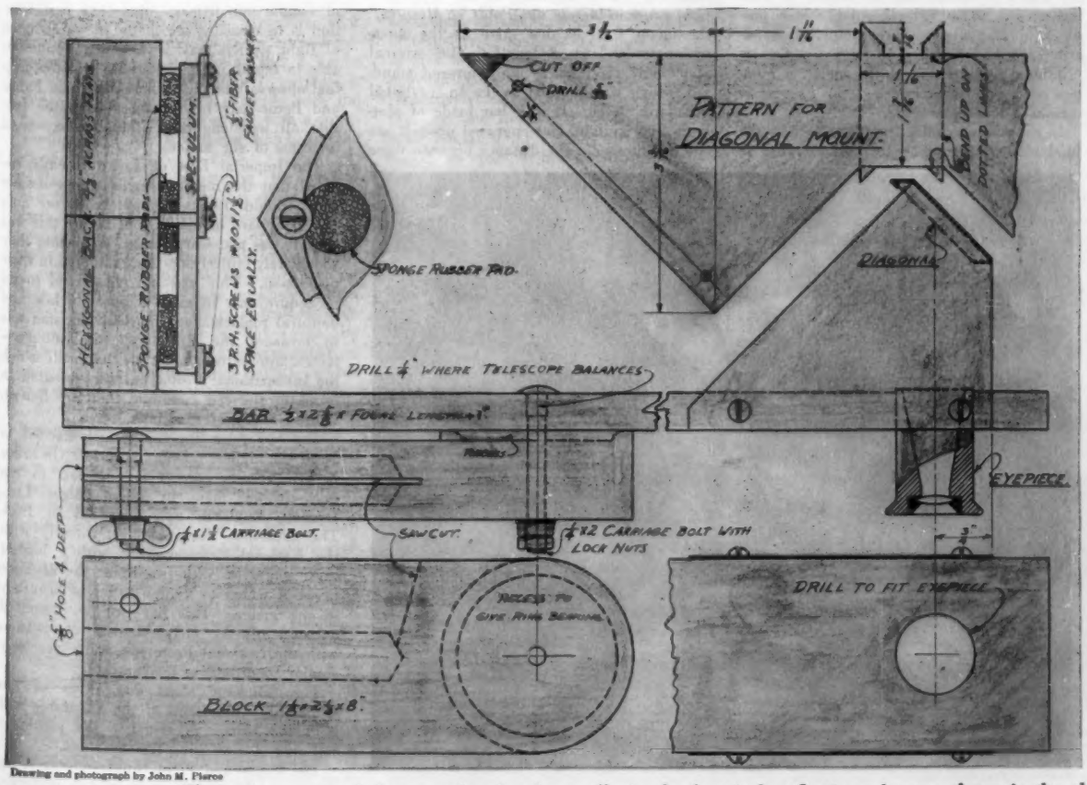
Cut out a bow (Figure 4, above) from a pine board, making it about 20 inches long with about one inch of curve. String it with a piece of belt lacing, tying one end and having a hole in the bow for the other end of the string to be slipped through. Make a wooden handle (Figure 1) by boring a 9/16-inch hole, 4 inches deep in a piece of broom handle. Force a short length of brass tubing (or a cartridge shell with the end cut off) on one end of a piece of ½-inch solid dowel rod, 10 inches long. (Figure 2). Let the tubing project about ½ inch beyond the wood.

Place the glass on top of the bench and clamp upon it a piece of board having a notch to act as a guide for the cutter. Assemble the drill by dropping two half-inch steel balls into the handle to act as a thrust bearing. Insert the dowel after them, wrap the bow string around the dowel, draw the string tight and tie the loose end. Hold the handle upright with the cutter resting against the notch and rotate by moving the bow back and forth. Place a little carborundum, about size 200, and water under the cutter.

As you work, you will soon see a circular groove being ground in the glass which in a few minutes will be cut through, leaving a circular core. This is the blank from which the lens will be made. Cement it to the bench with a little melted rosin. If it does not stick, wet it with a little turpentine.

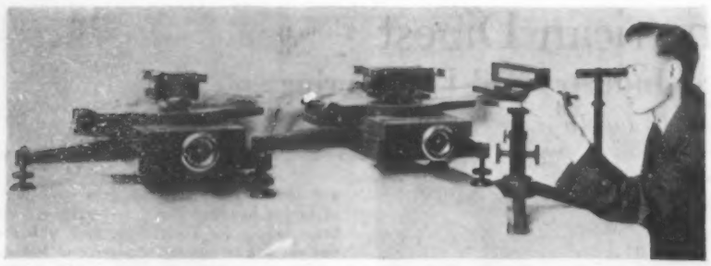
Fill your cutter with melted lead and press a ⅝-inch ball into it while it is still soft, thus forming a spherical hollow (Figure 3). Using this with the bow, grind the lens with carborundum and water until it has an even, spherical form. Swing the handle back and forth in order to even the grinding. You will need no guide. Reform the lead when necessary by pounding the steel ball into it. When the glass is ground to shape, wash it off and repeat, using finer carborundum. Finish grinding with the grade known as "60 minute."

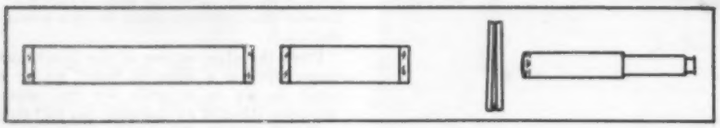
To polish the lens, melt and mix nine parts of rosin with one part of beeswax. Knock out or melt the lead from the cutter, and fill with this mixture. Before the pitch has hardened, form it with the ⅝-inch ball, as before. Polish with this tool, using jeweler's rouge instead of carborundum. When

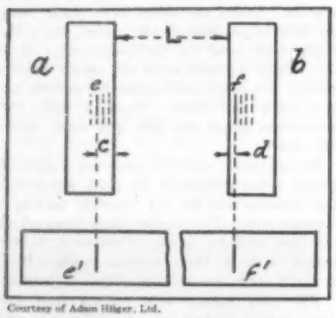


Drawing and photograph by John M. Pierce

The various parts of the mounting for the small, simple, four-inch reflecting telescope shown in the photograph at the right







Courtesy of Adam Hilger, Ltd.

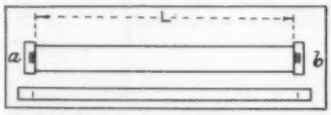
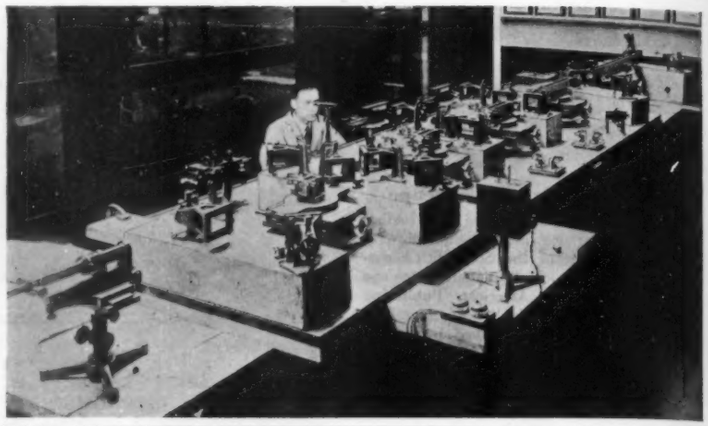
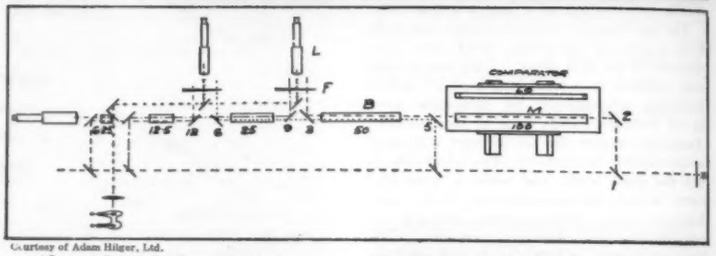


Figure 1. At top: the lame etalon or wedge film which compensates for any slight deviation in the optical length ratio of 2:1. Below the top illustration is a diagram which is analogous to it. In this column: how a one-meter etalon is compared directly with an invar bar. Note the fine lines engraved on the end plates. At left: detail of ends of etalon and invar bar shown at right, magnified





Courtesy of Adam Hilger, Ltd.

Above: how the length of the meter etalon may be calculated to 1 part in 10,000,000. Below: diagram of the process pictured above

polished, which will take several hours, you will have a finished plano-convex lens (Figure 5).

If you want a double convex lens (Figure 6), grind and polish the other side. A smaller forming ball will give a greater magnifying power, a larger ball, a less powerful lens.

The mounting for the telescope is made of wood, but any attempt to give detailed instructions would merely be duplicating those given by the accompanying drawings and the photograph on the preceding page.

The distance from the front face of the speculum to the center of the eyepiece hole should be two and one-quarter inches less than the focal length of the mirror. Adjust the joints of the mount so that they move easily. Rubbing them with soap or paraffin will help. Paint all wooden parts a dead-black color.

The base is made by fastening a ⅝-inch iron rod vertically in something heavy enough to support the telescope firmly. A gear from the scrap pile of a local machine shop furnished the base shown in the photograph. The rod is set in a wooden plug driven into the gear. A good base may be made by casting the rod in a concrete block. The telescope can be lifted from the base and taken indoors when not in use.

To collimate, or line up the mirrors, remove the eyepiece and put a round piece of cardboard having a ⅛-inch hole at its center, into the eyepiece hole of the bar. Looking through this you see the diagonal mirror and in it the reflection of the speculum. Bend the diagonal support until the speculum shows in the center of the diagonal. Next make a ⅛-inch ink spot upon the center of the silvered surface of the diagonal. Look through the hole in the cardboard again and you will see this spot and its reflection in the image of the speculum. Adjust the speculum by turning its three retaining screws until the reflection of the ink spot covers the spot itself symmetrically. Do not attempt to remove the ink spot. It does no harm, and is ready to aid in checking the collimation of the instrument at any time.

* * *

Measuring Standards of Length by Means of Wavelengths of Light

THE first practical step in the accurate determination of standards of length was taken by Michelson and Morley who, in making use of light waves, enabled a standard of length such as the meter to be measured with an error of not more than one part in ten million.

Before describing this apparatus a brief consideration of standards of length should show the necessity for its manufacture. In stating a length or distance in meters, yards, or other units, few give thought to the real meaning of these terms. To form a perfect standard, a selected length must be capable of expression as a multiple or sub-division of some distance to which it can be compared easily, and the latter distance must be related to some unalterable phenomenon, unalterable at all events, to our knowledge.

The English yard cannot be said to conform to this definition, since the existing standard is a copy of authentic copies of the Imperial Standard Yard destroyed in the fire which consumed the two Houses of Parliament in 1834. The United States possesses similar copies of the Imperial Standard Yard and also possesses two copies or "National Prototypes" of the meter, a number of which were issued from France to various countries in 1889.

In the United States the meter is now the fundamental unit of length and the yard is defined as $\frac{3600}{3937}$ meters. In the event of a difference arising between the Standard Yard kept in America and England, respectively, it would be difficult to determine which standard had altered and the ratio stated above would be of doubtful value. This, and other considerations, point to the necessity for measuring the Standard Yards in wavelengths of light, as in the case of the meter.

The meter originated in France at the time of the Revolution, and received very careful consideration. It was intended to be equal to exactly one ten-millionth of the distance between the North Pole and the Equator, but it was not made accurately so. Therefore, as a readily reproduceable standard it was not much better than the Imperial Standard Yard. In 1889, at the "*Première Conférence Générale des Poids et Mesures*," the meter was decided upon as the international standard of length. The original meter was replaced by an improved standard, which was adopted as the International Standard Meter. It is a bar made of platinum and iridium, and engraved upon it are two fine crosses. The distance between these crosses at the temperature of melting ice is defined as a length of one meter.

It was found, however, that in spite of all precautions some of the Prototypes, owing to secular changes in the metal, altered in length to the extent of as much as one part in two hundred thousand. These discoveries made it vitally necessary to devise a means of checking the constancy of the meter, and a method of doing this was suggested in 1889 by Michelson and Morley, who proposed to measure it in wavelengths of light. This was carried out by Michelson in 1892 and 1893, and again with different apparatus by Benoit, Fabry, and Perot in 1905.

Instead of specifying the meter as the length occupied by an exact number of wavelengths of light of a definite radiation—which would make an ideal standard capable of simple sub-division—the next best solution is to measure the meter in wavelengths of light, which may be considered unalterable in length. The importance of the original observations of Michelson, Benoit, Fabry and Perot may be estimated from the fact that all wavelengths of light are expressed in terms of the meter.

The Imperial Diet of Japan recently decreed that the meter, previously permissible only, should become obligatory as the only legal standard of length, but before this was done it was necessary to decide whether they should rely entirely on the Prototype in their possession. This was not considered sound procedure and, in view of possible loss and doubtful replacements, the final decision was to measure the Prototype with interferometric apparatus similar to that with which the International Prototype was measured in terms of the red cadmium light by Benoit, Fabry and Perot.

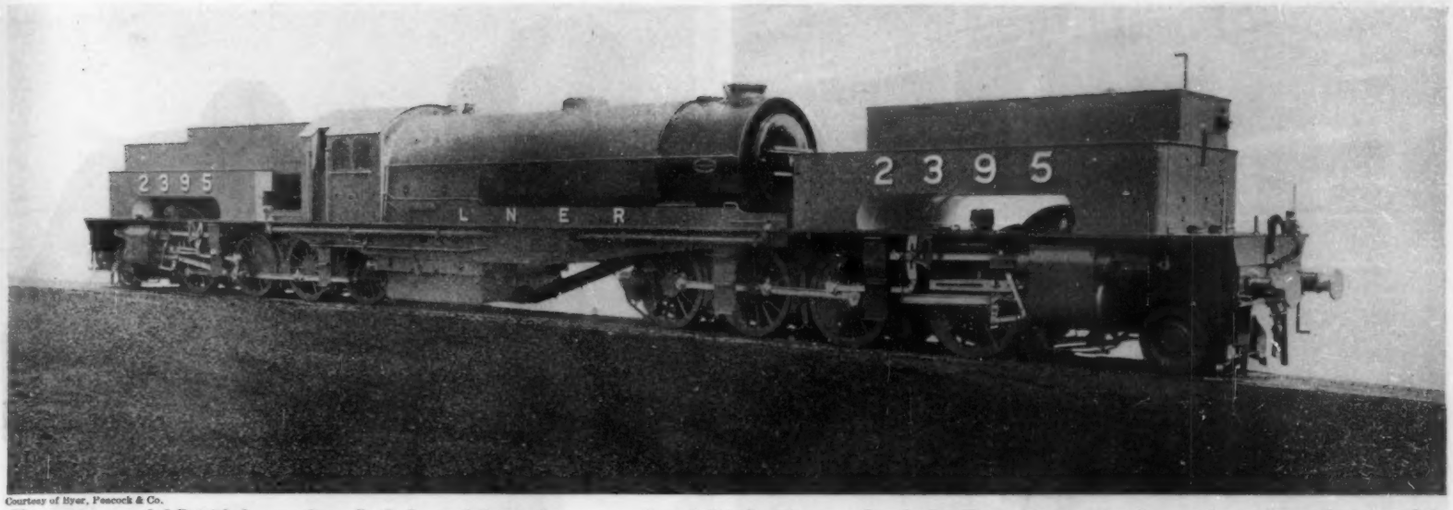
The apparatus for this, which needed to be of the highest possible accuracy (in order to give results correct to one part in ten million) was made by Adam Hilger, Ltd., London, England, and delivered in 1924. The apparatus does not deal directly with the National Prototype but with a bar of invar engraved with two lines, the distance between which to a high order of accuracy is one meter. This bar can be compared subsequently by meteorological observation with the National Prototype under precisely similar conditions of temperature.

The following short description of the more unfamiliar items of the apparatus will help the reader to visualize the processes followed in measuring the invar bar.

The Fabry and Perot Interferometer is an instrument by means of which two perfectly

Courtesy of Adam Hilger, Ltd.

Two-centimeter and one-centimeter mounts for the derivation of constant A'



Courtesy of Hyer, Peacock & Co.

The most powerful British locomotive. Built for assisting trains over grades of 2½ feet in every hundred. There are two complete engine units, each mounted in its swivelling truck. Each engine has three 18½-inch by 26-inch cylinders. The total weight of the locomotive is 398,804 pounds

plane mirrors, lightly silvered on their opposing faces, may be separated by any distance up to as much as 20 centimeters, without these faces losing parallelism.

An etalon consists of a pair of lightly silvered, flat mirrors separated by a fixed distance, the mirrors being maintained perfectly parallel by suitable supports on a rigid mount.

The "Lame Etalons" or wedge films each consist of two perfectly flat glass strips, lightly silvered on the inner faces and separated at their ends by very thin tin foil, the foil at one end being thicker than that at the other. The strips and foil are cemented together, and the slightly tapered block thus formed may be moved in the direction of its length and about a vertical axis. The thickness of the enclosed film of air is measured and calibrated in wavelengths of light.

The largest etalon, that of one meter length, is compared directly with the invar bar with the two lines, as shown in Figure 1. Close to the inner faces of the etalon plates *a*, *b*, are engraved a number of fine lines spaced at .050 millimeter intervals in the case of plate *a*, and at .054 millimeter intervals in the case of plate *b*. By means of a comparator fitted with microscopes and micrometer eyepieces it is found that a line *e* (lower left hand cut of Figure 1) on plate *a*, and a line *f* on plate *b* coincide with the two lines *e' f'* on the invar bar with a maximum error of .002 millimeter which may be measured.

The method of measuring the optical length of the "meter" etalon relies on the fact that if two etalons having a ratio of optical length equal to 2:1 are placed in train and white light is passed through them, a number of colored fringes with a central pair of black fringes may be observed. A slight deviation from this ratio may be compensated by a "Lame Etalon" or wedge film (described above). This arrangement is shown in the half-tone and cut at the top of Figure 1.

Five etalons are used, the longest of which is nearly one meter in length, the others being one-half, one-quarter, one-eighth and one-sixteenth of this length within a few wavelengths. The five etalons are arranged in train and adjusted until the "white light" bands or fringes are obtained in turn through each adjacent pair. In order to isolate each pair of etalons when required, suitable mirrors are placed in position, and in the course of the observations small differences from the ratio 2:1 are compensated by means of the wedge films.

The shortest etalon, the distance between whose faces is nearly 6.25 centimeters, may be measured in terms of the red radiation of cadmium light. When the light is passed through an etalon a number of red and green rings may be seen, the measurement of which, in conjunction with observation made with the Fabry and Perot Interferometer, enable its optical length to be measured. Thus, by knowledge of the exact ratio of the optical lengths of the five etalons, the length of the "meter" etalon may be calculated to an accuracy of one part in ten million.

The complete arrangement of the etalons placed ready for comparison is shown diagrammatically in Figure 2, bottom, and also in the photograph. All the etalons are placed in a line and carefully adjusted so as to be accurately parallel. The comparison can then be made quickly without moving any of them.

If, for example, the etalon M, having a length of one meter, is to be compared with B, having a length of 50 centimeters, white light coming from X is reflected by the mirrors 1 and 2, and traverses M and B, the mirror 5 being moved out of the way. It is then reflected by the mirrors and passes through the compensating wedge film F, being finally observed through the telescope L.

The method of deriving the optical length L (see Figure 1) of the "meter" etalon has been described above. The small distance *c* and *d*, at left, which added together are known as the constant A, are measured by transferring the glass plates of this etalon in turn to two short etalon mounts of about one centimeter and two centimeters length respectively. Comparison is then made of the engraved lines, *e*, *f*, with a centimeter scale engraved on a short invar bar. Observations made with a micrometer eyepiece enable the lengths *c*, *d* to be calculated with the same precision as the length L. Thus the distance between the marks on the meter invar bar is measured in terms of wavelengths of light. The invar bar is compared subsequently by meteorological observation with the Prototype under precisely similar conditions, the latter being absolutely under control.

* * *

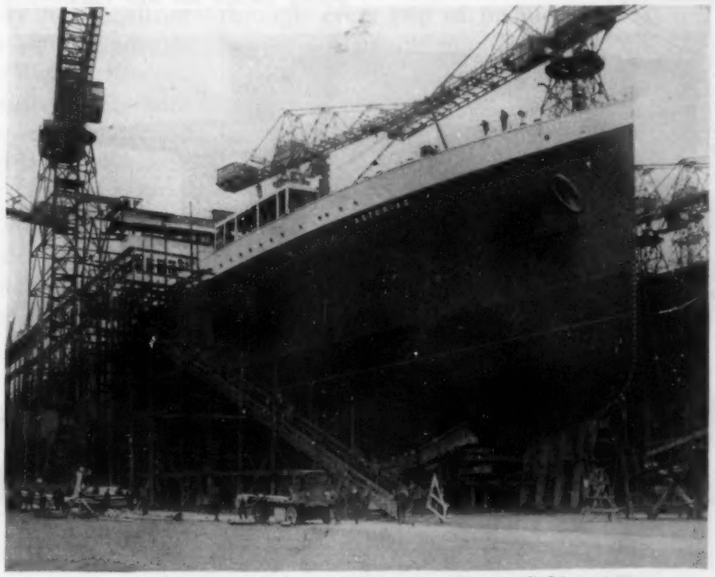
The Largest British Locomotive

THERE has recently been placed in service a British locomotive that is by far the largest and most powerful ever constructed in Great Britain, which embodies many novel features in its design. It was built for the London and Northeastern Railway, for pushing service. In this work it is as powerful as two or three helpers, which hitherto had been necessary in carrying coal trains weighing about 900 tons over a stretch of two miles, on which the grade has a rise of 2.5 feet in every hundred feet. The total length of the run up grade is seven miles. The locomotive weighs 398,804 pounds of which 322,308 pounds are carried on two sets of driving wheels, one at each end of the locomotive.

As will be seen from the illustration, the engine consists of two distinct locomotive units. Each of these has three cylinders, one on each side of the frames and one between the frames. All the six cylinders are 18½ inches in diameter and 26-inch stroke. The driving wheels are 56 inches in diameter. The steam pressure is 180 and with 85 percent cut off, a tractive force of 72,940 pounds is developed.

Because the rails on English railways are rather light for a locomotive of this weight, it was necessary, in getting out the design, to pay careful attention to the distribution of the weight. Hence, as will be noticed, the load is distributed over a considerable length of wheelbase. The maximum load on any axle is 41,093 pounds of which 158,984 pounds are on the front group of drivers and 162,324 pounds on the rear group.

The front tender carries water only, for which it has a capacity of 2,800 gallons. The rear tender has a capacity of 2,200 gallons of water and seven tons of coal.



A bow view of the world's largest oil-engined ship

* * *

What Is Life? How Does Evolution Work?

IN the world of the biologist, two perennial and basic questions that have never been answered are: what is life? and, are acquired characters inheritable?

Is life simply a chemico-mechanical process, some sort of a test-tube phenomenon, pure and simple—or is it something more subtle, something deeper, more ungraspable? From these two considerations we get the two theories of the nature of life, the mechanistic and the vitalistic.

The other mooted question is, are acquired characters inherited? "No," say the great majority of biologists, "they are not, because there is no physical mechanism by means of which they could be inherited." Nevertheless, a fairly large group of biologists maintain that acquired characters *are* inherited, whether we can account for it or not. Certain physical characters acquired during the individual lifetime of a parent animal are passed along, these biologists maintain, to the offspring. If this could be proved, we would thereby have established the *method* by which evolution takes place, a thing which we have not as yet, however, found out.

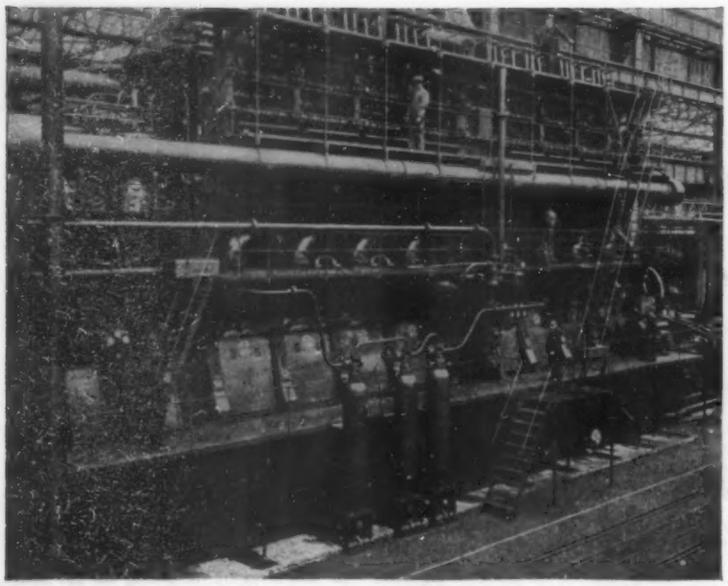
Both of these great questions involve or draw in with them many other important biological considerations, and the whole matter is more ably summarized in Professor Seba Eldridge's new book, "The Organization of Life" (Crowell) than the present writer has ever seen it done within a single pair of covers. Professor Eldridge has his own theories concerning these questions, but he presents all the extant theories impartially—judicially.

* * *

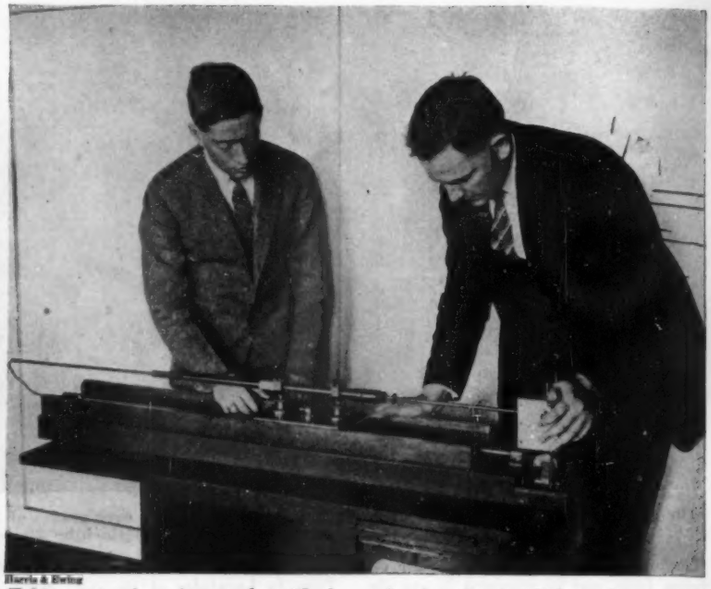
The World's Largest Motor Ship

UNDOUBTEDLY, the outstanding fact in the development of the world's merchant marine is the rapidity with which the Diesel marine motor, in its various modifications, is ousting the steam engine as the main drive for power driven shipping.

Our illustrations show the latest and largest passenger motor ship, the *Asturias*, built by Harland & Wolff for service between New York and South America. She is a 22,500 ton ship and her dimensions



One engine of the twin-engined Diesel-oil ship *Asturias*, of 22,000 tons. It has a total horsepower of 20,000



Harris & Ewing

Taking a moving picture of a rifle bore, showing the tiny light and periscope and the camera containing the film

place her well up among the large steam-driven passenger ships of the present day. She measures 655 feet 8 inches over all; her breadth is 78 feet and her depth is 45 feet. She is a handsome vessel and shows all the distinctive characteristics of the modern Atlantic liner.

The ship provides accommodation for about 1,800 persons including passengers and crew. She includes all those refinements which have been worked out in steam-driven vessels in the way of ventilation, hot and cold water supply, and means of recreation.

It takes but a glance at our illustration of one of the twin engines to show to what mammoth proportions the marine motor engine has grown. This view shows a complete unit as erected on the floor of the shop, and a striking impression of its size is afforded by the men who are seen standing on the four successive platforms that occupy the full height of the motor.

Each of the twin-screw main engines is designed to give a normal output of 7,500 brake horsepower or 10,000 indicated horsepower per shaft. Each unit consists of eight cylinders, 33 1/8 inches in diameter, the common stroke being 59 1/8 inches. The engines are designed to run at a service speed of 115 revolutions per minute.

* * *

The First Electrically Welded Steel-Frame Building

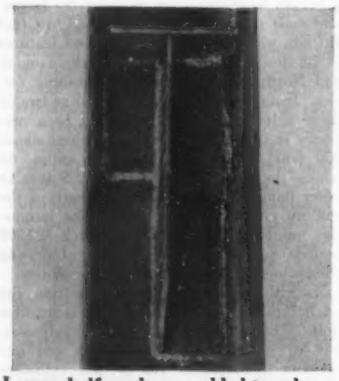
THE completion of a new, fifteen-thousand-dollar, two-story-and-basement commercial building in the heart of the business section of Canton, Ohio, is considered to mark the assured acceptance of electric arc welding for joining members in the fabrication and direction of steel structures of certain types.

The framework of the building was entirely electrically welded, both in shop fabrication and in erection. Not a single rivet was used to join any of the various members of this heavy-duty building, which measures 100 by 150 feet in plan.

The building was originally designed for rivets and, the change to welded connections, was made not to cut costs but to secure a more satisfactory job. Moreover, welding not only provided 100-percent joints in place of 65-percent riveted joints, but there was an important saving both in money and in time.

The decision by the construction company to substitute electric welding for riveting, was based upon experimental and shop work. Extensive tests made for many years were examined and a series of special tests were made which proved to the engineers' satisfaction, the superiority of the welded joint.

Three men operating "staple-arc" welders did all the welding in the fabrication of the structural steel, and a total of 14,694 linear inches of welds went into this operation, which was completed in 80 percent of the time which would have been necessary had riveting been used. The total number of welds made at the plant was 4,171, which varied in length from 14 inches to two and a half inches. In addition to the welding work at the shops, 780 welds were made on the job after erection. One operator made a total of 4,294 inches of welds in 120 working hours.



Lower shelf angle, as welded to column, on which girders are fitted

Tests have shown that two linear inches of 1/4-inch welding bead equals the shearing strength of a 3/4-inch rivet; but two and a half inches was adopted as a standard length, equal to a 3/4-inch rivet in shear. Actually, on the Canton job most of the welds are three inches long.

The architects point out that in designing structures for welding, in the future, it will be possible to simplify considerably the structural work over the requirements for a riveted structure; since the connections could be made much less complicated than those necessary in riveted work.

* * *

A New Way of Examining the Inside of a Rifle Barrel

BY means of an ingenious new device not only is it possible to obtain an accurate image of the entire inside of a rifle barrel, but the impression of it is recorded automatically on a motion-picture film for future reference.

This new camera is the first apparatus ever designed which makes possible the photography of the whole interior surface of a .30 caliber rifle barrel, with the impression recorded on a moving film. This development is to be credited to I. C. Gardner and F. A. Case of the Optical Instrument Section of the Bureau of Standards, and the invention is especially valuable to the United States Army in studying the wearing qualities and other characteristics of the different kinds of steel which are employed in the manufacture of various rifles.

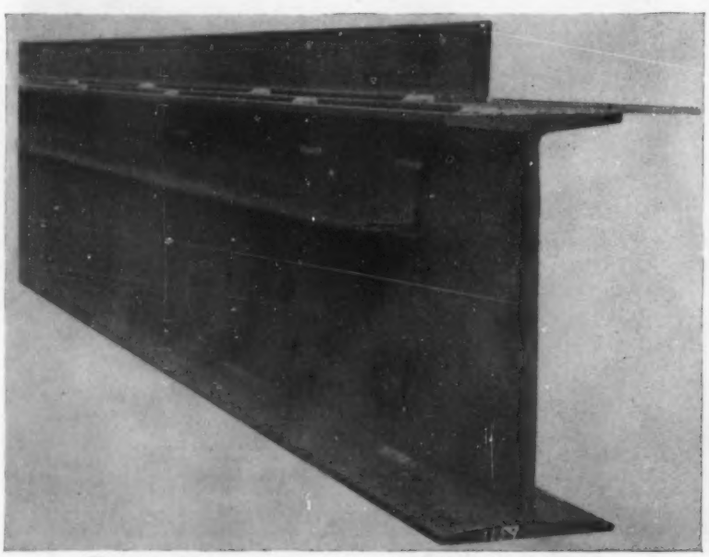
The principal parts of this camera consist of a tube or periscope about 30 inches long, an electric lamp supported by a tube inside of the rifle barrel, by means of which the picture is taken, a prism which reflects the image down the 30-inch periscope or photographic tube, and a photographic film taken from a motion-picture camera. At present this elongated camera is operated by hand but eventually it will be hitched to a small electric motor.

As the rifle barrel moves back and forth along its appointed course or track the motion-picture film moves at a corresponding speed. This synchronism of the movements of the gun barrel and photographic film obviates any blurring of the image which otherwise might be caused by the motion of the rifle barrel. The film-moving mechanism and barrel are connected by means of gearing. Conventional rolls or spools are provided upon which the moving-picture film is wound.

All rifle barrels, of course, wear out after continuous use over a considerable period of time. Some barrels, however, withstand the effects of firing for a longer time than others, due to the kinds of steel employed. The new camera will not only serve the purpose of determining the course of wear of rifle barrels, but by observing the behavior of different rifle barrels in service the United States Army will be enabled to choose suitable steel for the manufacture of small firearms. This camera scrutinizes the interior of a rifle barrel with the same fine accuracy that an X ray machine reveals a defect in the human body.

Those who have served in the army infantry will appreciate with amusement how a device of this sort recently threw a company of the National Guard into dismay. This company, a peacetime organization, had cleaned its rifles for annual inspection, and though the men had labored hard in an effort to present immaculate rifle bores to the inspecting officers, they had anticipated that he would inspect the bores only in the usual manner of the past—that is, by holding them up to the light and squinting through them for ten or twelve seconds.

They were considerably dismayed, therefore, when this officer put in his latest annual appearance armed with a rifle bore periscope. Since this brought his eye into a far better position to inspect the rifle bores than it would be when simply looking down them in an almost parallel direction, he was able to find large accumulations of foreign matter that had eluded the eyes of the infantrymen. In short, this infantry company received a very low score on cleanliness of rifle bores.



This view shows wall support flanges welded to spandrel beam

The defender at the gates. Defective raw material "shall not pass" this alert tester. One reason why telephones are made right.

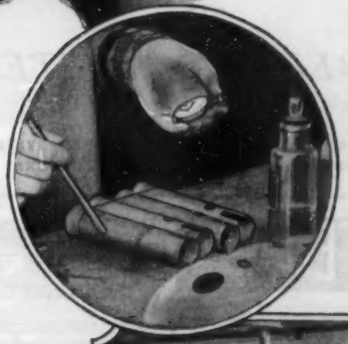
"They shall not pass—"

WITH this watchword of determination the French held back their foe at Verdun. Today "they shall not pass" is a watchword equally determined in Western Electric telephone making—only here it always means "defective materials and apparatus shall not pass."

Inspection, inspection, inspection is the order of the day in this work of making telephones and telephone equipment.

From the raw material stage, when strength tests and quality tests are rigorously applied, through every step of manufacture, a telephone must qualify for service—and do so before a chain of critical inspectors.

This insistence on high standards of materials and workmanship is Western Electric's day-to-day part in making Bell telephone service the standard of the world.



The acid test. The coating on a telephone must prove that it can resist corrosion.

A machine imitates the hand, lifting and replacing a telephone receiver. An endurance test.

Back of your telephone

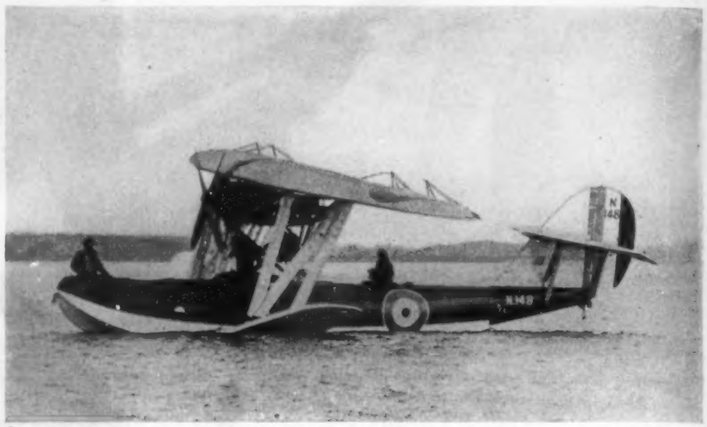
Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin
In charge, Daniel Guggenheim School of Aeronautics



© Kerston-New York
The English Electric Company's seaplane. As in the Dornier, the lower wing becomes a part of the hull as far as prevention of rolling in the water is concerned

No Wing Floats

A FLYING boat, however broad its hull may be, needs wing tip floats to protect the tips of the wings from the water when the seaplane rolls from side to side. These wing tips are quite effective, but they increase the resistance of the seaplane without contributing in any way to the lifting capacity of the wings. Both German and English designers have therefore sought to dispense with wing tip floats.

The German Dornier plane *Pacifico* (which recently landed at Palm Beach, Florida, after travelling 4,000 miles from Colombia, South America) is really a monoplane; but, instead of wing tip floats, wing stubs are placed on either side of the hull. These are metal covered, can resist the impact of the water, and effectively increase the rolling stability of the hull, yet they provide lift and therefore do not diminish the aerodynamic efficiency.

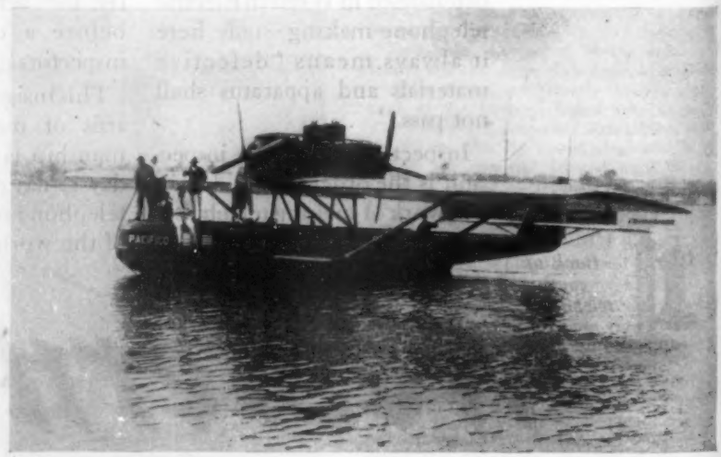
A new English method of dispensing with wing tip floats is really no different from that of the German design. The lower wing of the English Electric Company's seaplane (shown in our photograph) acts as a lateral stabilizer for the hull in precisely the manner as do Dornier's wing stubs.

Dornier's plane is not new. A seaplane of the same type was used by Amundsen in his Polar flight. But the photograph makes interesting study nevertheless. The two tandem engines (which give a maximum of security against power plant failure) are beautifully streamline in their single nacelle. The whole construction gives an impression of great solidity. There should not be much danger of the engine mounting giving away and the engines landing on top of the occupants even in a very bad landing. The wing stubs from the hull not only increase its rolling stability but also serve to anchor the wing struts and relieve the upper wing of some of the air forces acting on it.

A Mystery Bomber

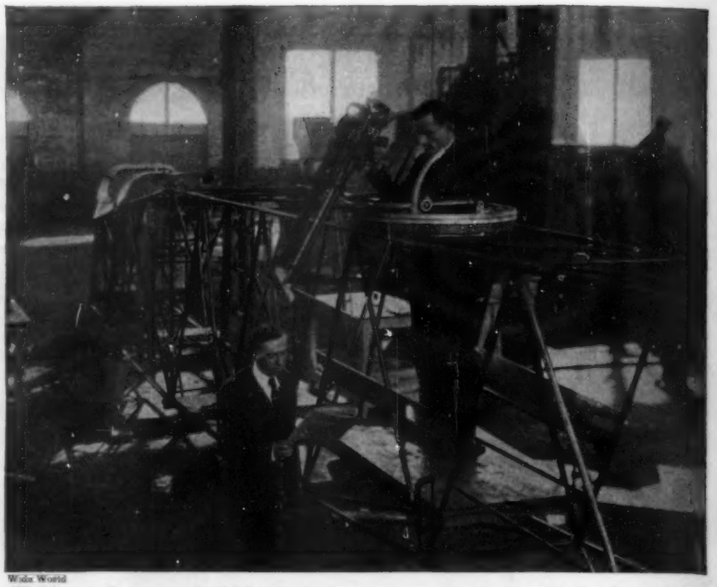
THE Huff Daland Airplane Company are building a new bomber for the Air Service, which is still kept somewhat of a mystery by the Intelligence Service. Such information as has been issued is interesting. The *Cyclops*, as the new plane is termed, is perhaps the largest single-engined bomber ever built. Its engine must develop at least 700 to 800 horsepower. Fully loaded it will develop 135 miles per hour, and with a gross weight of 17,000 pounds it will carry a useful load of 9,000 pounds. This in itself will be a great achievement. For a plane to carry over 50 percent of its gross weight in useful load is something we have scarcely heard of before. If such a useful load is indeed available, then the company's statement that the plane will have more than sufficient fuel

(*Continued on page 264*)



Acme
The Dornier flying boat *Pacifico* which recently flew from Colombia, South America, to Palm Beach, Florida. The cleverly designed wing stubs eliminate the necessity for wing tip floats

Photograph shows one of the units in a typical industrial installation of the American Blower Venturafin Method of Heating



Wide World

Welding is being used widely in airplane construction, as in this fuselage of the *Cyclops*. A bomber must be protected from the rear. The gunner, standing up, can direct his guns in almost every direction

for a non-stop flight from New York to London is entirely credible.

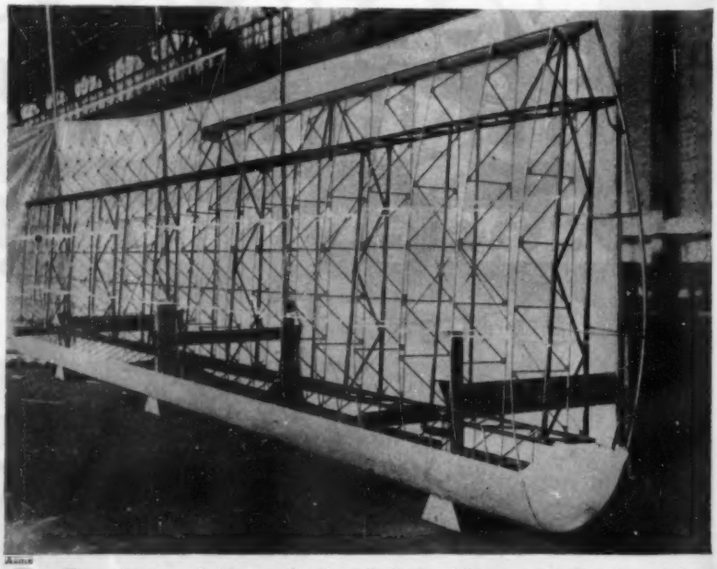
The British Air Ministry has recently announced that it will discard wood construction in all its new construction, and that five years will see the British air fleets built entirely of metal. From the photographs of the *Cyclops's* construction, with which this note is illustrated, it would seem as if our Army Air Service were adopting the same policy. There is not much wood to be seen in the photograph of the giant wing, not yet covered with fabric so that the entire internal construction is visible. The two main girders of the wing, or spars as they are called by airplane designers, are made of seamless chrome molybdenum steel, which under certain conditions of heat treatment develops a strength of 200,000 pounds per square inch, or nearly four times as much strength for a given cross-section as the mild steel that goes into our boilers or skyscrapers.

The wing girders are built up in exceedingly simple fashion. Two long tubes, running the whole length of the wing, constitute the upper and lower "flanges" of the wing girder. Short tubes of the same material, welded to the top and bottom beams, constitute the girder webs. Nothing easier in manufacture or assembly is imaginable. The wing ribs, which are parallel to the line of flight and transverse to the wing girders, are evidently of duralumin, and are also of good constructional form. These ribs transfer the lifting power of the air on the fabric to the wing girder and also serve to maintain the aerodynamic contour of the wing. Airplane designers are now learning to build these ribs with the utmost lightness. A huge rib of some 15 feet in length will weigh only 20 ounces and yet resist a total load of hundreds of pounds when tested to destruction.

Perhaps this is an age where welding will largely displace riveting as a method of fastening metal to metal. We hear of welded boilers and even welded ships. In the *Cyclops* not only are the wing girders welded, but the entire fuselage likewise, as can be clearly seen from the first of our photographs, where the lengthy longerons and the shorter tubes—top, bottom and sides—are all welded together without the use of a single rivet.

A bomber is primarily an aircraft which can throw bombs on the enemy, but it must be able to defend itself from attack by agile single-seater fighting ships. It must have guns to sweep the sky in all directions. Hence the provision of very carefully de-

(*Continued on page 266*)



Acme

The all-metal wing of the new bomber *Cyclops*. The very simple wing girders are welded of seamless chrome molybdenum steel of enormous strength. The transverse ribs of duralumin are strong and light

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REGISTERED U.S. PATENT OFFICE

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Pacific & Atlantic

Figure 1: R. J. Munkittrick, left, aviation chief rigger, and Lieut. B. P. Donnelly under whose direction Russell chutes are being tested. Note twists in lines. Chutes dropped in this fouled condition open almost upon leaving plane

signed gun-turrets at the rear of the airplane. The gunner, if standing in the rear gun emplacement, can with a few movements direct his two guns almost perpendicularly down the sides of the body of the airplane, can swing his turret round in a circle or fire his guns upwards at any angle. Almost as much ingenuity is exerted by aircraft designers in securing the greatest area of unimpeded fire as in building the structure of the airplane itself.

A Novel Parachute

IN experience with the standard Army Air Service parachute, it has been found that no mechanism is necessary to open it. Once the rip cord has been pulled and the fall has become rapid, the air is trapped in the top of the chute into a compressed ball which rapidly increases in size and forces the chute out. Army parachutes are rendering the greatest possible service. Their drawbacks are that they require skilful and careful packing, that they can be designed as a rule to open only after a fall of at least two seconds or something like 60 feet of free drop, and that entanglement of the shroud or supporting lines during packing is a source of danger.

J. M. Russell, formerly of the Engineering Division of the Army Air Service, claims to have invented a chute which is free of all these objections. The Russell parachute is novel in that it is fitted with a series of valves placed along the entire wall of the chute, which permits intake of air along its entire length instead of at a bottom opening only.

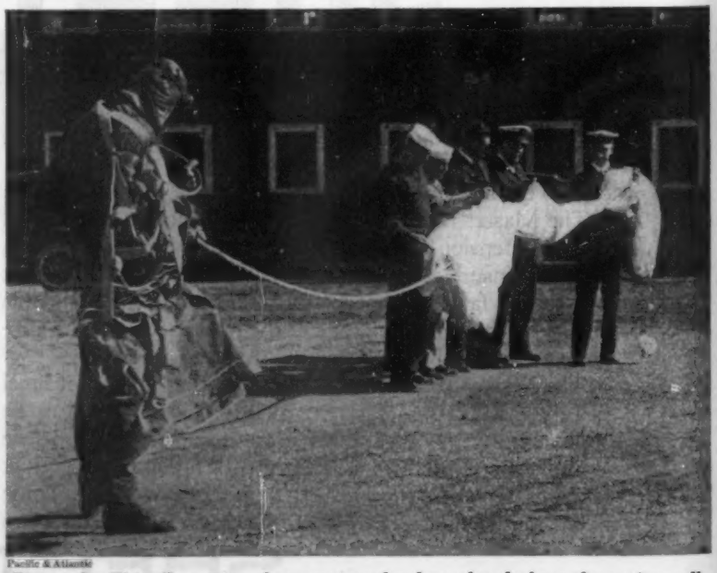
It is claimed that the Russell chute is useful for a drop from an altitude of as low as 100 feet, that the entanglement of the shroud lines is not to be feared, and that the chute can be packed without any special care.

Figure 1 shows the chute with lines twisted thoroughly, yet tests, with the lines in this condition, have been completely successful. In Figure 2 the men at the right of the photograph are indicating the air valves which are placed at various points along the chute.

Jet Propulsion

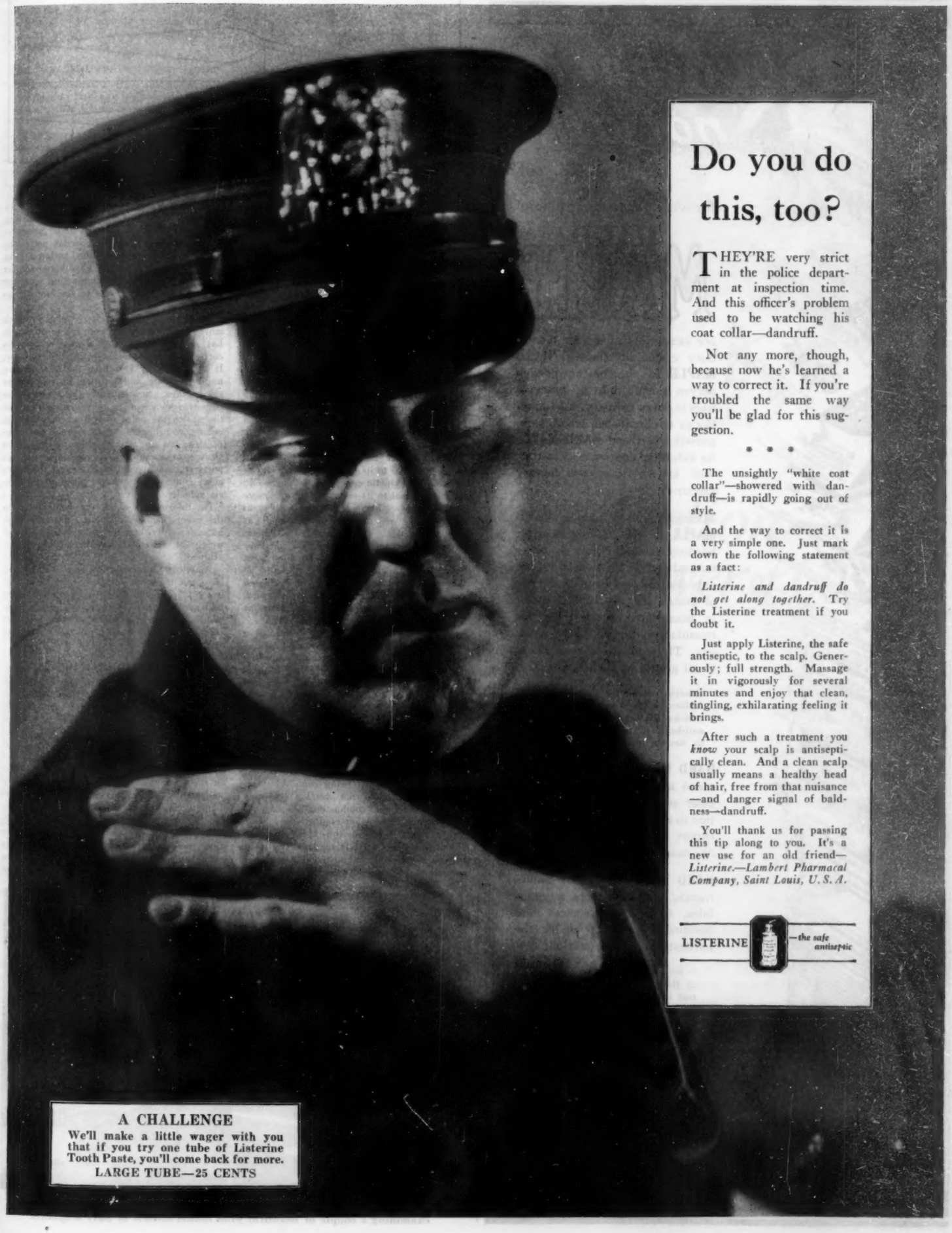
FOR a hundred years, perhaps, boats have been propelled in shallow waters by pumping water from the stream to the top of a tank, and then allowing it to escape at a fair rate of speed from the bottom of the tank, in a narrow jet. The reaction of the escaping jet was sufficient to drive the boat forward, even though the efficiency of the

(*Continued on page 268*)



Pacific & Atlantic

Figure 2: This illustration shows series of valves placed along the entire wall, which allows intake of air. No center valve is used which is different from all other chutes. Russell claims that center valve allows outside pressure to close chute or keeps it from opening. With his chute the air gets in and holds the wall open, as there is no outlet in the center



Do you do this, too?

THEY'RE very strict in the police department at inspection time. And this officer's problem used to be watching his coat collar—dandruff.

Not any more, though, because now he's learned a way to correct it. If you're troubled the same way you'll be glad for this suggestion.

* * *

The unsightly "white coat collar"—showered with dandruff—is rapidly going out of style.

And the way to correct it is a very simple one. Just mark down the following statement as a fact:

Listerine and dandruff do not get along together. Try the Listerine treatment if you doubt it.

Just apply Listerine, the safe antiseptic, to the scalp. Generously; full strength. Massage it in vigorously for several minutes and enjoy that clean, tingling, exhilarating feeling it brings.

After such a treatment you *know* your scalp is antiseptically clean. And a clean scalp usually means a healthy head of hair, free from that nuisance—and danger signal of baldness—dandruff.

You'll thank us for passing this tip along to you. It's a new use for an old friend—*Listerine.—Lambert Pharmacal Company, Saint Louis, U. S. A.*

LISTERINE —the *safe* antiseptic

A CHALLENGE

We'll make a little wager with you that if you try one tube of Listerine Tooth Paste, you'll come back for more.

LARGE TUBE—25 CENTS

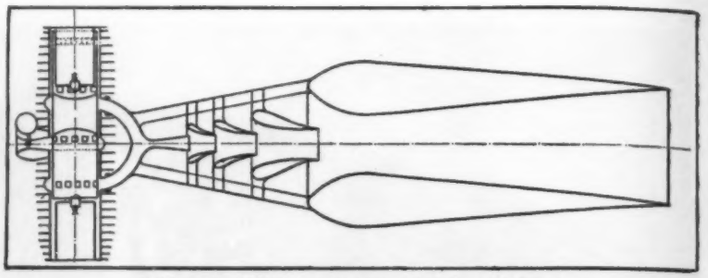


Diagram of Melot reaction engine for airplanes

mechanism was poor. The system has also been employed on lifeboats, where in exceedingly rough water neither oars nor a screw propeller give assurance of propulsion. Is it possible that the principle of jet propulsion may be applied to the airplane? We read in the *London Engineer* and in *Automotive Industries* that the French *Service Technique de l'Aeronautique* is testing out an airplane power plant invented by H. F. Melot which is based on the principle of jet propulsion, the energy of the gas being converted directly into propulsive effort without the intermediary of connecting rods, crankshaft and screw propeller.

The latest form of Monsieur Melot's invention is shown in diagrammatic form. If gas under high pressure after combustion were allowed to escape from a chamber in a narrow jet, its velocity would be tremendous. Now the reaction of the gas would be proportional to its mass and *to its velocity of exit*. The kinetic energy of the gas would be proportional to its mass and *to the square of the velocity*. For a jet issuing with great velocity, the reaction would be small as compared with the tremendous loss of kinetic energy at exit. To improve the efficiency of conversion, the gases of combustion must be mixed with air inside the apparatus, so that the speed of discharge is decreased while the mass of the discharge is increased. This explains the presence of the four air injectors shown in our diagram. The exhaust gases pass from the combustion through a pipe and meet four air injectors each somewhat larger than the preceding one. Each injector draws in a larger quantity of air, so that finally a mass of air and gas emerges at a relatively slow speed.

Monsieur Melot started his experiments five years ago. Even at that time, he understood the necessity for the air ejectors. But in his early work, he simply burned kerosene in a combustion chamber lined with fire brick. This was exceedingly simple, but the kerosene, not being compressed before ignition, could not develop the high pressures and the combustion efficiency of the internal combustion engine.

The latest form of the Melot reaction engine embodies what is really a two-cycle, internal combustion engine. The new device consists of a horizontal cylinder inside which there are two walls forming a chamber. In each wall there is a spark plug for starting the engine with gas injected under pressure. There are three series of annular ports, the central orifices placing the carburetor in communication with the chamber, and the end ports being in communication with the exhaust pipe which leads to the first air injector.

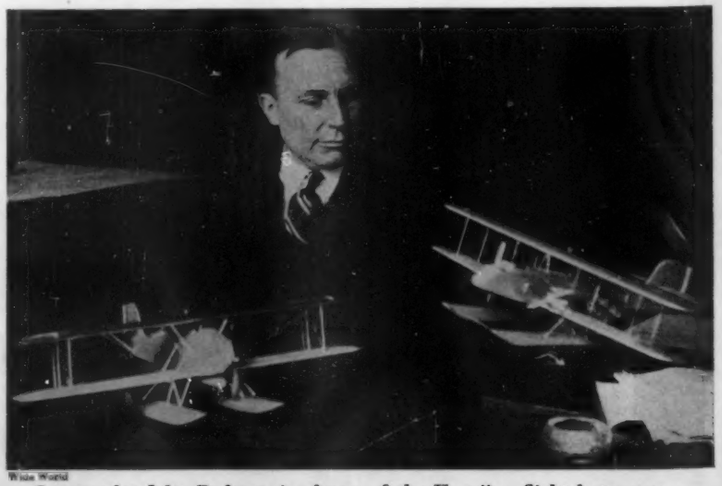
Inside the cylinder is a piston which moves freely from one end to the other. It has concave faces and sleeves with ports corresponding with those in the cylinder. It is started by injecting the gas mixture under pressure and igniting by one of the spark plugs. Subsequently the speed of the piston is sufficient to raise the pressure of the gas to the point of self-ignition and the engine continues to run without the compressor and the spark plugs. The piston sleeves are arranged to open the exhaust ports at such a point as to ensure the burnt gases entering the exhaust pipes at the highest velocity.

No information is as yet available as to the exact efficiency, although this is said to be satisfactory, and for every two pounds of weight of apparatus one horsepower is developed.

American investigations on the subject have put in doubt the possibility of obtaining any great efficiencies, but for exceedingly high-speed planes the simplicity of the apparatus and the elimination of the propeller lead us to think that further developments are worth watching.

Wind Tunnel Models

OUR photograph has a double interest. It shows us Commander John Rodgers, U. S. N., who was in charge of the Hawaiian flight last autumn and who has now taken over the duties of Assistant Chief of the Bureau of Aeronautics in the Navy. And it also shows us some beautiful wind tunnel models of navy seaplanes, used for testing in the aerodynamic laboratory the efficiency and stability characteristics of the full-sized plane. Since even a slight change in the contour of the wing may induce an important change in its aerodynamic characteristics, these models, particularly as regards their wings, have to be made with exceeding accuracy. Sometimes intricate model wing



White World

Commander John Rodgers, in charge of the Hawaiian flight last autumn, examining a couple of beautiful wind tunnel models of navy seaplanes

shapes in metal are made so accurately as to be right within 1/1000 of an inch. There is nothing in the model maker's art to equal this accuracy, not even in the construction of yacht models, formerly considered its crowning achievement.

Our New Automatic Safety Code

THE International Convention for Air Navigation held at the same time as the peace negotiations at Versailles (October, 1919) laid down definite rules and regulations for aerial navigation. The United States alone of all the great powers has failed to ratify this convention, whose adoption has greatly increased the security of flight in Europe, Canada and South America. Since there has not been enacted in the United States any Federal legislation in regard to air travel, American flying is almost completely unregulated. And unregulated flying may be dangerous to the public and the fliers alike. It is therefore very satisfactory to see the Society of Automotive Engineers, the Bureau of Standards and the American Engineering Standards Committee collaborate in producing the Aeronautic Safety Code, which covers every phase of aircraft operation: structure; power plant; equipment; signals; airdromes and airways; traffic rules; qualifications for airmen, and so on.

While this code is not mandatory it will be of great utility in acquainting operators and the public alike as to what should be done to promote safety. A boiler safety code, or a code for testing steam engines no longer offers much romantic interest. But the Aeronautic Safety Code in spite of its formal presentation still contains paragraphs that appeal to the imagination. Some of them follow:

Kadel & Herbert

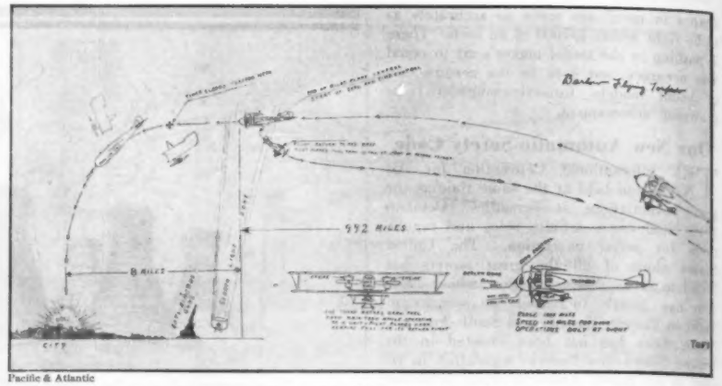
An acetylene lighthouse has been installed at the London Terminal Airdrome, at Croydon, which automatically lights up when the sun sets, and goes out as the dawn breaks to daylight conditions. The small valve which controls the light is contained in the glass cone on the right-hand side of the lighthouse

"The whole control system shall be so arranged that it is impossible for it to jam in any part as the result of any conceivable sequence of movements." We can readily imagine the feelings of a pilot who finds his controls jammed.

"The control mechanism shall be arranged so that it cannot be jammed by loose objects inside the fuselage, baggage under the seats, the clothing of a pilot or passenger. . . ." We can remember one accident where the rudder bar was entangled in a lady's moderately long skirt, with fatal injury to pilot and passenger alike.

We always think of flying as an open air proceeding, yet in an enclosed cabin passengers may be very greatly discommoded by lack of ventilation and the presence of gasoline fumes. The Code insists on 700 cubic feet of fresh air per hour for every passenger.

Nothing is so terrifying as fire in the plane and yet, with simple precautions, the danger



Pacific & Atlantic

Artist's sketch of the manner in which the Barlow Flying Torpedo functions

of fire may be almost completely eliminated. The Code has some very wise rules on the subject of fire prevention. Gasoline tanks are to be located as far from the engine as practicable, if possible on the wings and not in line with the engine. All tanks must be so constructed as to withstand shock, vibration and distortion. A fire wall, sheet steel with asbestos backing, must separate the engine completely from the rest of the fuselage or nacelle. There must be no inflammable fittings in the cabin. Air intakes of the carburetors must open completely outside the engine cowling so as to eliminate the danger of back-fire igniting a collection of gasoline vapor under the cowling. These precautions are simple, but, alas, not always followed.

Landing gears on new designs are to be dropped from heights of almost three feet to test their strength, or at least designed to withstand such severe impacts.

Airdromes must have wireless, beacons, and so on.

Collisions seem almost impossible in the air, yet they have happened. The Code defines right of way as carefully as the traffic regulations of New York City.

Altogether the Code is a mine of simple and useful information and rules and its study by operators will do a great deal to make American flying safer.

A Curious Suggestion

THE Barlow Flying Torpedo seems to have aroused interest in Congressional circles and the idea is a curious one. Therefore, we feel justified in describing it, with many reservations as to its practicability. The torpedo really constitutes the fuselage and tail surfaces of a large twin-engined airplane with a long range of flight. Rigidly fixed to this twin-engined plane and below it, is a small pilot plane. The pilot controls the large machine by electrical devices, can release his own craft at a certain point and also times the release of the torpedo from the rest of the structure of the large airplane. From the time of its release the torpedo is to be controlled by gyroscopic devices. Perhaps the two sketches give a better idea than our description of the principles and functioning of the device. The pilot plane on the outward flight draws its gasoline from the main tanks, and therefore need only carry sufficient fuel for its own return journey.

Here are a few of the objections which immediately come to mind:

The inventor claims a range of 1,000 miles on the outward journey for his device. The lone pilot has to have extraordinary powers of endurance to fly unaided a distance of 2,000 miles.

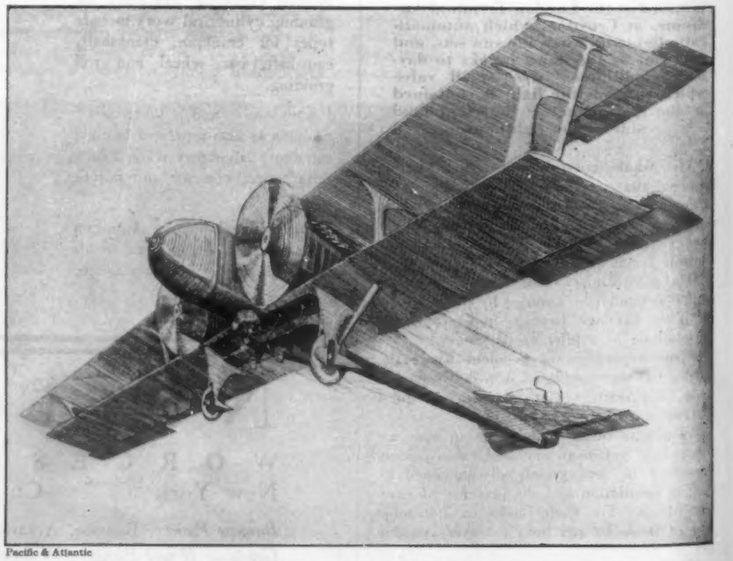
It is easy to speak of electrical devices controlling the large machine, but it is not so simple to control even the ordinary twin-engine airplane for one man, and there would be quite a number of electrical and mechanical complications to overcome.

If the torpedo is to fly a thousand miles, part of the time there will be no sheltering darkness, and at such time the craft would be entirely at the mercy of enemy scouts—it would not have the multiplicity of guns and gunners which a bombing plane always carries.

The launching of every torpedo would mean the loss of a plane and valuable motors, in contradistinction to ordinary bombing operations where the bomb alone is launched.

In ordinary bombing operations, given sufficient altitude the bomb can be launched at a good distance from the objective.

In aeronautics it is never safe to discourage any device, but there are in this invention quite a number of difficulties to consider.



Pacific & Atlantic

Artist's sketch showing manner in which small pilot plane is fixed to a twin-engined airplane with a long range of flight

Science Notes

Setting the Clock in Camp

FEW campers have escaped the annoyance of finding that they have forgotten to wind the only watch in camp, and that they are therefore without knowledge of the time.

Sunrise and sunset move, in the latitude of New York, over a range of some three hours; and on a given day the sun itself, in its apparent motion across the sky, travels fast near the horizon and slowly near the meridian. There is, however, one feature of sun time which is fixed; the sun is at its highest at noon. This makes it easy to determine the time quite accurately.

Erect a pole of any height and measure the length of the shadow which it casts as early in the morning as is convenient. With the pole as a center, swing a circle, using this distance as radius. In the afternoon, after having contracted to its minimum and again lengthened out, the end of the shadow will again reach this circle. Then the shadow at true noon lay half-way between the two points thus marked. If the watch were started at the time of the morning observation, the correct time at the moment of the evening observation is obtained by dividing in half its record of the elapsed time.

Thus, suppose an early reading were taken, a shadow length of thirty feet seven inches noted, and the watch set going from the eight o'clock mark. The afternoon shadow, let us say, reaches the same length as 4:42 by the watch. The elapsed time is eight hours, forty-two minutes. Half of this was before noon, the other half after. The correct time at the moment of the evening reading is then 4:21.

The longer the period of the day over which the test runs, the greater the accuracy.

How Long Is a Seed's Life?

BEET seeds retain their germinating power for 17 years, according to experiments recently conducted by Professor K. Dorph-Petersen, of the Danish Seed Testing Station. A considerable number of these seeds were stored away seventeen years ago and some were withdrawn every year for experiments. The tests showed 85 percent of germination the second year and twenty-four percent the seventeenth year of dormancy. Seeds of white clover germinated after twenty-five years. Only a few grass species tested showed much life after seven or eight years. It would also seem that environmental conditions may influence the length of time a seed may remain alive.

Grafted Oranges and Lemons to Grow in Deserts

THE cultivation of oranges, lemons and other citrus fruits in regions that are at present too arid for them is expected to result from the accidental discovery at the U. S. Experimental Station at Indio, California, of the proper method of grafting flowers and fruit on the Australian desert lime tree.

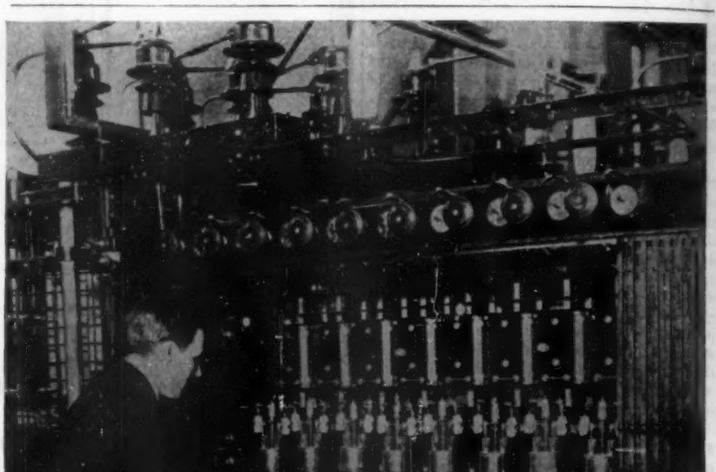
This is the only plant that is closely enough related to citrus fruits to permit grafting, and that will also grow under desert conditions in alkaline soil, and in greater cold than other citrus species will stand. Therefore, as a stock on which citrus fruits may be grafted, it has long been expected to extend the range of orange and lemon culture into regions hitherto unsuitable for these fruits.

The only difficulty thus far met with has been that this species would not produce seed, no matter how generously irrigated. No seed, no grafting stock! A specimen that stood near an irrigated terrace, and received a constant small trickle of water surprised workers at the station by breaking into bloom; whereas other trees that had had their roots copiously flooded once a month refused to put forth a bud. This hint was therefore that the trees really needed a constant though small supply of water, instead of intermittent floods. An abundance of young seedlings are now available for propagation purposes.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



International Newsreel

The vacuum-tube power unit of England's most powerful station. The big British station is at Hillmorton, near Rugby, England

Rugby's Range Is World-wide

THE new British station at Rugby, England, with its total power output of 1,500 kilowatts, is being heard in all sections of the world according to reports reaching the station.

Two-thirds of the power is used for wireless telegraph communication and one-third is reserved for long-distance radiophone experiments. The code messages will be broadcast on long and short waves. The radio telephone plant is designed to cover 5,000 miles. Twelve masts, each 820 feet high, hold the aerial wires aloft. It is expected that the long and short-wave equipment at Rugby will insure satisfactory transmission to every part of the Empire throughout the twenty-four hours.

Foresees Broadcasting of Heat

BROADCASTING of heat by radio is predicted by Professor S. E. Dibble, of the Carnegie Institute of Technology and President of the American Society of Heating and Ventilating Engineers. He contends that it is no more improbable to broadcast heat waves than it is to broadcast sound waves. But, before this can be done, he points out, research workers must discover instruments to control heat waves, chiefly a detector which will intercept the waves, hold and amplify them.

"Transmission of heat by atmospheric conductivity is essential because of the gradual exhaustion of the elements of fuel," said Professor Dibble. "The day is not far off, in my opinion, when we shall see huge centralized heating plants broadcasting heat to homes, industries and office buildings. Our hope is to incline the activity of research men toward this objective. We know that heat travels through space, through solids, and when we once learn how to pick up these waves and control them, heating throughout the world will be revolutionized. Heat broadcasting will mean better health to the public, because it will eliminate from the air the impurities of present-day heat-making systems."

Radio Centre for New York

A RADIO Centre has been established as a permanent exhibition and market for radio products by the Bush Terminal Company, of New York. Two floors in the Bush Terminal Sales Building and more than 20,000 square feet of space has been leased to the Radio Centre, Incorporated. Colonel S. H. Mapes is President of the new company.

The Radio Centre is intended to be a sort of bourse for radio manufacturers and a service market for buyers. Instead of traveling from one end of the city to the other to make comparisons, the buyers can see the products of many manufacturers under one roof. Sound-proof booths have been installed so that each exhibitor can have absolute privacy and the radio parts can be exhibited under actual working conditions.

Madrid Broadcasts at Late Hour

MADRID, Spain, stays on the air later than most of the other European broadcasters, and may be heard between 7 and 8 P.M., Eastern Standard Time, on the 392-meter wavelength. Dance music is generally the feature on the late Spanish program.

KMOX Pays Talent

KMOX, "The Voice of St. Louis," pays its program artists according to reports from the studio. The payroll for entertainers and station staff totals approximately $3,000 a week.

Yucatan Blamed for Static

THE crashing and grinding static noise which disturbs radio listeners in the United States originates in the atmosphere of Yucatan and Mexico, according to Dr. L. W.

Telegraphone

Radio compass of the S.S. *Alaunia*. Instead of using a revolving loop antenna as its direction-finder, this ship has a fixed frame or "box aerial," which is attached to this receiver for determining the ship's position

Austin, of the Bureau of Standards. It is believed that "upside-down" lightning, which consists of a steady discharge of electrical energy from clouds into a conducting layer high above the earth of Central America, is the chief source of static.

Observations show that there are three types of static disturbances, all of which originate from different causes. The frying or grinder noise is known as grinder static; and it is the most troublesome. Sharp clicks caused by a lightning storm form the second type of static, and a hissing sound, caused by heavy snowstorms, is rated third.

When Marconi made a trip across the Atlantic in his yacht *Electra* in 1922, he made extensive observations of static. He reported that up to about half-way across the sea, the disturbances appeared to be coming from the vicinity of the African coast. At more than half-way across, the strays apparently originated over the American continent.

Tests made by radio engineers reveal that up to very high wavelengths, the increase in static's intensity is proportional to the wavelength. It has been estimated that static is about 20 times as strong on 17,000 meters as at 3,000 meters, and that above 25,000 meters there is a decrease in the static intensity.

Observations made at stations along the Atlantic seaboard indicate that strong static in the afternoon and night is produced in the southwest. Static picked up in the morning and in the winter seems to be evenly distributed in regard to source.

Static noise is usually at a minimum about 1:30 A.M., and just after dawn, when there is a deathlike silence in the ether. Its maximum volume is reached from 10 P.M. to midnight. If static is noisy from about 6 A.M. to 10 A.M., it can generally be taken as a warning of an approaching electric storm or a decided change in weather.

Up to the present, there is no device or system to entirely eliminate static. The strength of an incoming radio impulse at the receiving set is estimated to be one-millionth of an ampere. Thus, it can be readily understood that a heavy charge of lightning, more powerful than all the broadcasting stations put together, has a great influence in the ether and should have little difficulty in sending a click around the world.

Germany Extending Radio on Trains

RADIO telephony on board German trains between Berlin and Hamburg has been so successful that other trains are to be equipped, according to Ernest Schmitz, a representative of the German railroads, who recently visited the United States.

"Despite the noise inseparable from a train," said Mr. Schmitz, "and despite the constantly changing distance over which a

Kadel & Herbert

Telephone and radio, supplementing each other, bring passengers on the trains running between Berlin and Hamburg within communication range of home. The train's operator establishes the contact between passenger and telephone exchange

Fotogramo

Recording the size of short radio waves on his wave meter. Mr. W. W. Salisbury, at the State University of Iowa, has produced Hertzian waves 1.3 meters in length. His new wave meter, shown in this photograph, is used in experimenting with very low wavelengths

three-minute radiophone conversation is carried on, the trains cover some three miles during the talk and the audibility leaves nothing to be desired. The connection is made as speedily as in the case of the ordinary long-distance call."

To receive a call on an express train is just as simple and easy as to be called to the phone by a page boy in a hotel lobby, according to Mr. Schmitz. A messenger boy with the lettering, "Train Telephony, Ltd." on his cap passes through the trains and announces the telephone calls received at the trains radio station. The person paged follows the boy to the radio compartment of the coach, where a telephone operator presides over the switchboard. Near her is an ordinary telephone booth and the person called enters the booth and is connected with the person making the call in Berlin or Hamburg.

The train passengers can likewise make calls. The charges are slightly higher than those of a long-distance telephone conversation.

The station on the train is a combination of telephone and radio. There are three transmitting stations on the Berlin-Hamburg line, one at both cities and one mid-way. The aerials of the train station are located on the roof of the cars.

San Francisco's Antenna Rules

REGULATIONS governing the installation of radio antennas have been issued by the Department of Electricity of San Francisco. No antenna shall be erected over any street or any wire carrying more than 600 volts, or be fastened to any pole supporting light or power lines.

There shall be a vertical clearance of at least eight feet over any flat roof and four feet over any peaked roof. All wires used to support the antenna shall be either copper or galvanized and not smaller than number 14 gage. No antenna or supports for the same shall be attached to a fire escape.

Lead-in wires shall not be smaller than number 14 gage and must be substantially supported, to prevent the wires coming in contact with any light or power wires. The ground wire may be bare or insulated, but it may not be smaller than number 14 gage and must be securely fastened to the pipe.

Radio Service for Farmers

A RADIO service department has been organized by the Department of Agriculture to supply agricultural program material to broadcasting stations. Samuel Pickard is in charge of the new bureau.

Much of the material furnished to the stations will be prepared for presentation in a radically different manner from the universal practice of reading manuscripts. The broadcasting stations will be asked to provide personalities who have unmistakable qualifications to voice the information, which in most cases will be presented in popular style and in the form of dialogue or questions and answers.

"Fifty Farm Flashes" will be offered as a regular feature. The "flashes" will consist of interesting current information sought by farmers through the several thousand letters received each week by the department in Washington.

Other special feature programs are under consideration, among which are the "Housekeeper's Half-hour" and the "National Farm School." In the latter, the farm will be considered as the student's laboratory. Timely lecture courses which dove-tail with the daily farm work will be developed, and laboratory assignments will be made which necessitate putting into practice the subject matter taught over the air.

Short-wave Station Makes New Record

STATION 2GY, an amateur short-wave station at Garden City, New York, established a new record for low-power transmission by carrying on two-way communication with station 9CCQ, Braymer, Missouri, using only .04 watts power in the plate circuit of the transmitting tube. Both stations employed standard receiving tubes and "B" batteries as their power source. The transmission feat of 2GY represents 25,525 miles per watt.

Assuming a cost of ten cents a kilowatt hour, the highest prevailing rate charged by power companies, this transmitter's plate current can be supplied for eighty-five years, eight hours a day, at a total cost of one hundred dollars.

If radio messages could be radiated as efficiently throughout the universe, the largest 100-kilowatt installations could be heard over a distance of 2,552,000,000 miles, sufficient to reach the distant stars of the solar system; and Mars would be within easy range of the larger broadcasting stations.

At an average rate of transmission of 20 words a minute, the power to send a message of 40,000,000 words would cost only one dollar, if purchased at ten cents per kilowatt hour; while this same transmission over telegraph lines at the rate of a night letter would cost $576,000.

"Broadcasting" Wins

AT a meeting of the National Association of Broadcasters the question was raised relative to substituting the word "radiocasting" for "broadcasting." It was unanimously decided to use "broadcasting."

Kadel & Herbert

Radio set with thirty-two loudspeakers. This method of comparing the quality of reproducers is used by J. D. R. Freed. By means of a switching device, any loudspeaker can be put into use and an electric light in front of each speaker is illuminated to show which instrument is in operation

Station OKP

A 5-KILOWATT Western Electric broadcast transmitter is now in operation at Prague, Czecho-Slovakia, and can be heard on the 368-meter wavelength. The broadcasting hours are: 5 to 6 A.M., 10 to 11 A.M., and 3 to 4 P.M., Eastern Standard Time. The call is OKP.

Minimizing Code Interference

THE Navy Department has called attention to shore radio stations regarding the prescribed silent periods. Naval transmitters of a type likely to cause interference to broadcast reception are supposed to remain silent between 7 and 11 P.M., Eastern Standard Time, except in cases of emergency. Ships are requested to co-operate by refraining from calling the shore stations during this desired silent period.

Station GBR

ENGLAND'S powerful transmitter at Rugby is known in the ether as "GBR," and it can be heard on the 18,000-meter wavelength. It registers in America and other parts of the world with strong signal strength.

Egypt Hears WGY

THE 41-meter wavelength of WGY is bringing in reports of reception from all quarters of the globe. C. W. Biddulph, of Alexandria, Egypt, reported: "Very clear phone strength. Every word clear as a bell. Your program concluded at 7:30 A.M., our time, and as the announcer closed down WGY's short-wave transmitter the sun was rising rapidly up over the desert."

Unique Aerials Used at KDKA

STATION KDKA is using two distinct antenna systems, one an upright copper tube and the other a flat top horizontal structure. The former is for short-wave broadcasts and the latter for the 309-meter programs, which the majority of broadcast listeners within the range of Pittsburgh hear.

The station's engineers claim that it has been practical to build the upright antenna so that its natural wavelength is close to the wavelength radiated from the aerial. This means that very little tuning of the aerial is required and the losses of power through tuning are minimized.

The fundamental wave of the horizontal antenna is not quite so close to that of the radiated wave.

Wooden poles, dried and treated with a water-proof preparation, hold the aerials aloft and insulate them from the earth. This is a departure from the use of steel structures.

The wavelength used in the short wave experiments is around 60 and 65 meters, and the short-wave aerial is approximately half a wave in length. Several aerials are used in the low-wave transmitting system. These aerials are located with the idea of obtaining directional effects for long-distance relaying. Each aerial consists of a copper tube supported vertically on a wooden pole, with a small horizontal counterpoise element at the lower end, and about four feet from the ground. Long porcelain insulators hold the tube rigid.

The length of the short wave radiated by the transmitter expressed in feet is approximately 200 feet. The aerial is a few meters less than half the length of the wave which it radiates; but the short horizontal counterpoise at the bottom of the tube and the lead-in connection with the apparatus help to compensate for the deficiency in length and bring the natural wavelength of the aerial near that which is broadcast.

In order to make necessary tuning adjustments of the aerial circuit, the copper tube is cut in half near the middle, and a ground coil is placed in the space between the two sections of the tube. Slight adjustments of this coil make it possible to tune the aerial circuit so that its natural wavelength is exactly that which is transmitted.

Only one of the several short-wave aerials is coupled to the broadcasting equipment. The others are located at certain predetermined distances from the main aerial and are energized by induction. Their purpose is to give the directional effects. When two of the aerials are separated by exactly half a wavelength, the signals have maximum strength at right angles to a line drawn between the two aerials. If two aerials are separated by a quarter of a wavelength, the condition is reversed.

An upright aerial is not used for 309-meter broadcasts because it would require a mast nearly 500 feet high.

Community Programs Beneficial

CINCINNATI reports that community programs radiated from station WSAI have unexpected and unsolicited commercial value. The Cincinnati manufacturers and wholesalers sent out monthly invitations to their mailing lists, and a substantial increase in business was noticed.

Ireland Goes on the Air

THE first broadcasting station in the Irish Free State has been built by the Marconi Wireless Telegraph Company in the McKee Barracks on the outskirts of Dublin. The wavelength is 390 meters and the call 2RN. The transmitter is rated at 6 kilowatts and is similar to most of those used by the British Broadcasting Company.

IN THE EDITOR'S MAIL

A Lasting Impression

An interesting item which came to us in our mail tells how impressions made by leaves which fell, quite by accident, on a city street nine years ago are being studied to determine the wearing qualities of concrete.

Authorities on concrete have been paying particular attention to the "leaf section" of Myrtle Boulevard, Sioux City, Iowa, where falling leaves left their impressions in the pavement nine years ago just as the concrete was being laid.

It is believed this accidental marking of the street surface may provide a valuable index of the rate of wear of concrete pavements under city traffic, a matter about which very little is known even among cement and concrete experts. The accompanying picture shows one of the imprints.

Some of the impressions are in the wheel tracks where 1/32 of an inch of wear would have obliterated them. Nevertheless, during nine years of their existence none has shown any wear from the traffic, despite the fact that from 500 to 700 vehicles traverse the boulevard daily, many of them steel-tired farm wagons.

Much speculation has developed as to how many years longer the leaf impressions will last in the pavement. The one shown herewith happens to lie near the edge of a curve in the boulevard, where wear is heaviest. Since nine years of rolling traffic have had practically no effect on the delicate tracery of veins in the imprint, engineers have predicted that a much longer time must elapse before the impression of the leaf is actually worn out.

H. S. McCauley.

How Many Others Have Done This?

It is with all due modesty and something akin to pride that we publish the following words of commendation from C. N. Wheeler:

Scientific American,

Gentlemen:

Although I was not born until 1879, I have read every number of the Scientific American (and of the Supplement) since 1876, paradoxical as it may seem.

My father was a contractor and engineer and when, in 1876, the Supplement was started he subscribed for it and after reading preserved the periodical. I do not know whether he had previously subscribed to the Scientific American or not, but, beginning with 1876, he preserved all the numbers of both the Scientific American, and of the Supplement, keeping them in large boxes in the attic.

When I came of an age to read with some ease I used to go up in the attic and spend hours poring over these old papers. To me they possessed a fascination beyond any childhood books. I would often ask my father about articles I had read in them, and he would explain points I did not understand. In his work he often referred to back numbers of both papers so that he gave me the task of filing and keeping filed both magazines. Finally, I became so the master of the contents of these volumes that whenever he had need of reference to an article or a subject he would tell me what it was and I would go and dig up the required numbers. My father often said that I brought him articles on the subject, or allied subjects, which he had forgotten or did not know had been published in the papers. As long as I remained at home I kept up this practice. I feel that the Scientific American, and the Supplement, have been great factors in my education.

Although I am not an engineer, or a contractor, I still enjoy the Scientific American and find it very useful in my present calling, that of owner of a private school preparing men and women—

Impressions made in concrete by a fallen leaf. This impression has withstood nine years of wear

World's first rotor ice boat on Androscoggin Lake in Maine. This boat was designed and built by Carlisle A. Lincoln who describes it on this page

from sixteen to sixty—for colleges and technical schools. In eleven years not one of the pupils I have sent to college has failed in his work there, and I have sent pupils to such exacting schools as Massachusetts Institute of Technology, Harvard, Yale, University of Pennsylvania, Worcester Polytechnic School, West Point, and others. I think my success has been due in no small measure to the habit of thoroughness and accuracy instilled into me by my father and the Scientific American, and Supplement.

During a short stay in New York a goodly number of years ago I got to talking with one of the caretakers of the Brooklyn Bridge. He was much surprised at the knowledge I showed of the construction of the bridge and asked me if I were an engineer engaged in steel work. All my knowledge of the structure had been gained in my youth by reading the articles in the old numbers of the Scientific American and in other works on bridges, the Scientific American articles having stirred my curiosity to pursue the subject still further.

I could quote many other instances where the articles in your paper have been the entering wedge to further research.

At present, when the Scientific American arrives, it is a rush to see whether my son or I get it first.

Very truly yours,
C. N. Wheeler.

A Rotor Ice Boat

Mr. Carlisle A. Lincoln of Wayne, Maine, has sent us pictures of a new rotor pleasure and ice boat which he has constructed. Excerpts from Mr. Lincoln's letter follows:

The size of the "rotor motor" and a few of the details, may prove interesting. The rotor body is three feet in diameter and is eight feet high, with flanges top and bottom each six feet in diameter, the flanges being twice the diameter of the rotor. The top and bottom flanges with the intermediate fin are made up of wallboard, held in place, attached and reinforced by spruce cleats. The outer surface of the rotor is also built up of wallboard sections. Pipe of different sizes serves to support the rotor and one of the pieces of pipe emerges and forms a flag staff. The cylinder revolves on a floating oil sliding bearing at the base, and a floating oil bearing at the top of the apparatus.

To spin the rotor, a round belt from a pulley on the rotor passes to a much smaller pulley on the top of the flywheel of a two-horsepower, two-cylinder, outboard motor. The motor being a one-way engine, a straight and a crossed belt are used so that either belt can be used to revolve the rotor in opposite directions for the different tacks.

The outboard motor is attached on the ice boat by an upright plank well braced to the main frame. The propeller of the motor is taken off and the shaft put into a five-gallon oil can with a section of the top intact. When the can is filled with water it acts as a part of the cooling system. The motor can be swung back or forward at will to allow the belts to slip so that the motor can start first with a loose belt and then tightened to spin the rotor. When the rotor is humming like a top, the motor and belt is set to position and this speed can be controlled entirely from the motor. This ice boat gathers speed rapidly as there is nothing to hold it back in its frictional contact on the surface of the ice. The ice boat is of conventional design.

The same rotor outfit was previously used on a pleasure sail-boat craft, except that in its installation the mast was shorter to allow the rotor to be as close to the deck of the boat as to bring the center of gravity as low as possible.

Determination

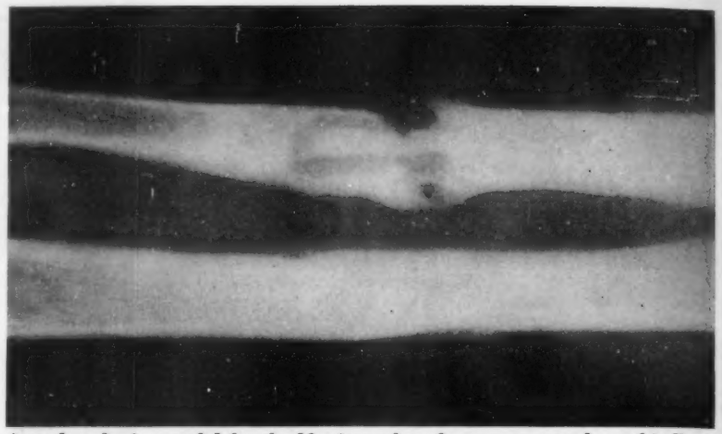
Here is an interesting letter from a Marine who wanted to make a telescope, two or three years ago, but could find neither the proper directions nor the materials. Owing to his inability to get the finer grades of abrasives, he was forced to do his fine grinding, in addition to polishing, with rouge, an abrasive that cuts, quantitively, extremely slowly. It took him 200 hours! He stuck—he was a Marine.

Sir:

I have my instrument practically finished, it being the result of some idle star-gazing in some of the South Sea Islands two or three years ago. The following chronicled interest in telescopes dates, therefore, from my first sight of the Southern Cross.

Grinding on the mirror started with what little knowledge was retained from an article published some ten years ago in "The Experimenter," or some magazine of similar nature. The process of pitch polishing with trimmed-down squares near the edge of the polishing blank was retained, but the Foucault test was so hazy that recourse

The rotor principle applied to a pleasure craft. As will be seen, the mast is shorter than that used on the ice boat



A reader who is grateful for the blessings of modern surgery sends us this X-ray picture showing how a surgeon made a dowel pin of a piece of shinbone, to repair his broken arm

was had to Herschel's scheme of sighting on a star as he ground out his figure. My method was perhaps pretty crude to start with, the moon being tried and the spherical blur removed; then Venus with removal of the blur, and then a star.

The greatest initial trouble was finding anything published concerning either lenses or mirrors, having searched some two or three dozen libraries between here and China. The few articles in the Library of Congress were of no immediate help.

It may interest some makers and perhaps excite the pity of others to know that I rough ground my glass with valve grinding compound and then immediately started in with the rouge; and that the rough grinding took only four hours, but the polishing took over two hundred hours. Bringing the figure from a sphere to a parabola took about eight. In explanation of the above, I found it impossible to get even flour of emery in Washington or nearby places, and no rouge, either (except from beauty shops). The rouge was finally begged from a mirror works.

With the abundant help consisting of information concerning sources of supply, the constructor should know something of his *possible* troubles in order to appreciate your help.

After reading the excellently clear exposition of the Foucault shadows by Mr. Porter in the February Scientific American, I tried my supposedly finished mirror by means of them, and found that my glass was somewhere between a hyperbola and a parabola. The fact that I used only a low-power eyepiece may account for my impression of having had a good mirror. About thirty minutes polishing brought the shadows on my glass to a counterpart of the short focus parabola shown in the illustrations at the top of your pages.

Sincerely,
Virl Davenport.

Marine Flying Field,
Quantico, Virginia.

Ingenuity of the Surgeon

Sometimes the modern surgeon patches us up just as one would patch up a torn suit of clothes—by taking out a piece where it is not needed and putting it where it is.

A reader in Tonopah, Nevada, sends us the following letter:

Editor,
Scientific American:

The writer was injured in a railroad wreck and was taken to Los Angeles to have a broken arm set. It was a double, compound fracture which occurred when a coach on the Tonopah and Tidewater Railroad, which was built to bring "Twenty Mule Team Borax" out of Death Valley, was derailed at the upper end of that depression. Seventeen days elapsed before I got out of Death Valley so that I might have an operation on my arm.

In December, 1922, a Los Angeles physician drilled the broken bones and laced them together with kangaroo tendons. The radius bone made a perfect knit, but the ulna wasted away. A year later, therefore, the same physician removed a piece of the shin bone and inserted it into the narrow canal of the ulna, thus making a dowel-pin. No screws or metal pins, no lacing and no plates were used. My age was then forty-eight, but I never was forced to walk with a cane or a crutch.

I now use both hands, can climb ladders and do almost anything. The arm is just a little stiff but this is due to the long period during which it was in a cast. The operation is considered a wonderful piece of work.

I have another rather interesting photograph that might also interest you. The shrikes are a large family of birds, known as the "butcher birds" from the fact that they impale mice, small birds, lizards and rodents upon thorns while still living, and probably return to them later for food.

Out on the Great American Desert, miles from water and trees, I was rather surprised to find a pair of loggerhead shrikes. They must have been migratory for I had never seen any before, nor since in such a locality.

Butcher birds impale their victims on thorns for safe-keeping. Here there was no thorn. A broken wire served instead

This photograph of a lizard, shows the way the lizard has been impaled upon a splice of a guy wire of a power line. This was so unusual that I caused the pole to be otherwise guyed, cut this piece of wire out and carried it to town to have it photographed.

While the habitat of the shrikes is varied, and the geographical distribution of their families is large, the desert environment is not expected to encourage their existence here.

Letson Ballet.

Notes and Queries

Conducted by Albert A. Hopkins

This department is intended for queries of general interest. Only a small percentage of the queries we receive can be printed here, the great majority being answered by mail. Except in special cases we cannot solve mathematical problems, give directions for building machinery or answer queries of a special nature which belong within the sphere of the professional engineer. All queries must give the name and address of the inquirer and must be accompanied by return postage. In writing about book orders or subscriptions please use separate sheets, give your name and address on each.

The Keeley Motor

DR. M. W. McD. asks: *"Can you give me any references to the Keeley fraud which were published in the Scientific American?"*

ANSWER: We are afraid that you will have trouble in getting the papers as most of them have been out of print for years. As you live in New York you can see them at the New York Public Library. Here is the list:

Number	26,	Volume	32
"	2,	"	22
"	3,	"	33
"	15,	"	51
"	5,	"	80
"	4,	"	80
"	23,	"	79
"	21,	"	108, page 473

In Volume 80 our own investigations at the Philadelphia Laboratory are described.

Weight of Rain and the Wettest Place

E. A. A. asks: *"How much would an inch of rain weigh to the acre of ground and where is the heaviest rainfall in the world?"*

ANSWER: These are both interesting questions. The weight of an inch of rain on an acre of ground would be 226,512 pounds. The wettest place on earth is Cherrapunji, India, where there is an annual precipitation of 457.80 inches.

Quenching of Copper and Brass

J. M. R. asks: *"How can I quench copper and brass?"*

ANSWER: Quenching copper, brass or bronze from a red heat will have no particular effect on the metal. In the case of red brass or yellow brass such quenching would require to be carefully carried out, otherwise the objects would break into pieces or crumble.

In foundries, brass castings of the different alloys in use are cooled by water right along; sometimes to "blow out" the cores and clean the castings, and occasionally to hasten their cooling for some impatient customer, or they may be chilled by water while in the mold to prevent local segregation which would cause the castings to leak under pressures, but such treatment produces no hardening effect, if anything they are softened thereby in small degree. Heat treatment is sometimes applied to certain alloys in cast form—the bronzes—but this is done to change the crystal formation to one more desirable, than to effect the hardness of the metal. The nonferrous alloys are not affected like the steels by rapidly cooling them.

Sulphur As a Fertilizer

A. E. H. asks: *"Can you give me information as to sulphur as a fertilizer?"*

ANSWER: We referred this matter to the Department of Agriculture and this is their reply:

"While the Department has not issued a publication on the subject we take pleasure in supplying you with information as follows: While it is unquestionably true that sulphur is essential to plant growth, especially in connection with the formation of certain essential oils, and for the proteins, which are present in all vegetation, yet the direct use of sulphur for different crops in the eastern part of the United States, particularly when fertilizers containing acid phosphate, kainit, manure or double salts, sulphate of ammonia or any other sulphur-carrying material is used, remains to be proved necessary. It is also true that, in general, the soils of the eastern United States appear to be fairly well supplied with sulphur in some form. In certain sections of the far west there are soils which seem to be strikingly deficient in sulphur and which respond to applications of either elemental or combined sulphur. These findings are based on experimental work conducted chiefly by the Oregon and Washington Agricultural Experiment Stations, respectively. Publications which have been issued by these stations may be obtained from them direct.

"In summing up the sulphur situation as it applies to soil fertility problems, we find that the use of commercial fertilizer or barnyard manure, which carry sulphur, tend to adequately supply the sulphur requirements of plants. Another source of supply comes from the rainfall, certain investigators estimating the annual addition of sulphur to be from six to eight pounds. This will vary in accordance with the location, whether in the country or near cities. On the other hand, the Rothamsted (England) Station estimates losses by leaching, based upon the yearly drainage from the experimental fields, to be about twenty pounds. Under such conditions, unless some material is applied to the soil which furnishes sulphur, the possible need of an artificial supply of sulphur will have to be given some consideration in connection with soil fertility research. This has been recognized in the far west, as has been pointed out, where investigations show the need of applying some sulphur-carrying material in order to obtain satisfactory crop yields.

"A more general soil fertility survey involving field tests may broaden the extent of soil areas to which sulphur may be profitably applied, but such studies have not yet been deemed necessary from the present state of our knowledge on the subject of sulphur as a fertilizer.

"Sulphur is being used to determine whether it is practicable to control potato scab by applying it to soils which are infested with the potato scab organism. Results of some promise have been obtained along this line. In such trials the principle involved has been one of making the soil more acid, at least to the point at which the scab organism fails to function actively.

"It might be desirable to suggest to your correspondent that he write to some of our State Agricultural Experiment Stations for their available publications on the subject in which he is interested.

The list of stations which follows may be helpful:

"Wisconsin Agricultural Experiment Station, Madison, Wisconsin;

"Illinois Agricultural Experiment Station, Urbana, Illinois;

"Kentucky Agricultural Experiment Station, Lexington, Kentucky;

"Ohio Agricultural Experiment Station, Wooster, Ohio;

"Kansas Agricultural Experiment Station, Manhattan, Kansas;

"Oregon Agricultural Experiment Station, Corvallis, Oregon;

"Washington Agricultural Experiment Station, Pullman, Washington."

Science and Money

Some Aspects of Rubber

By Henry C. Trundle

ALTHOUGH it is popularly believed that tire production is responsible for rubber company profits, there were many knowing shareholders of several such companies who, in January and February, were wishing for severe storms and slush so that their companies could dispose of the accumulated supplies of rubbers, boots and other footwear, because the sale or non-sale of these products would to a large extent determine the size of 1926 dividend payments. Naturally, however, with some 5,000,000 automobiles being turned out a year, practically all equipped with five tires, and with normal replacements of tires for all the millions of cars manufactured during the past 20 years which are still in use, this angle of the business is not to be minimized.

In fact, 62,000,000 tires were said to have been manufactured in 1925 in contrast to but 18,000,000 in 1916. These figures alone are an index to the enormous increase in the consumption of rubber and make it evident that problems of production and merchandising should arise. Henry Ford maintains that there will be eventually 30,000,000 automobiles in the United States. Unless some substitute for rubber tires is found, supply has its own little job of keeping up with demand all laid out for it.

The change in fashion from cord tires to balloon tires, together with the increased demand for tires, has been largely responsible for the shortage in rubber about which so much has been heard in recent months. The balloon tire utilizes a third to a half more rubber than the older cord tire, and as practically all the 1925 and 1926-model cars were equipped with them, the consumption of rubber has for that reason jumped far beyond former estimates of probable present requirements.

The British Monopoly

But what has been particularly responsible for the increase of its price is the fact that rubber is practically a British monopoly. We grow very little, if any, of our own, but purchase most of it from England and its colonies, who apparently have us at their mercy through a simple legislative act—the Stevenson Plan, which has considerably disturbed Americans.

This plan was adopted in 1922 at a time when over-production was imminent. This condition was to be avoided by restricting the exportation of rubber to "a fixed standard production assigned to each plantation." No effort was made to limit the planting of trees or to decrease production, as there was no intention to create a shortage either then or some five years afterward when new plantings would begin to bear. At the time there had been a great slump in the market price of rubber and enormous stocks of rubber had accumulated, adding to the general depression.

Producers, in accordance with the provisions of the Stevenson Plan, were allowed to export only 60 percent of their "standard production," but a scale was arranged whereby, if the price of rubber was maintained above 30 cents per pound for three consecutive months, an extra five percent in exportation should be allowed the next quarter; if the price was maintained at 36 cents, a ten percent increase was allowed. A decline from 30 to 24 similarly restricted exportation by five percent. The price was thus thought to be fixed at around 36, and indeed, it averaged about 30 cents a pound for two years thereafter. The year 1925 marked the turning point, the price rising from 36.7 cents in January, to $1.03 in July. Under the regulating plan, the export allowance was increased to 85 percent of "standard production," and later increased to 100 percent in February of this year. The Plan, under present price conditions, therefore, is non-restrictive.

Although intended to stabilize the industry, the Stevenson Plan has led to international friction and ambitious plans on the part of American rubber interests to disassociate themselves from foreign dependency. In refutation of the allegation that England, through operation of the Stevenson Plan, expects to pay off her War Debt to America, amounting to $4,000,000,000, arguments are put forth that the run-up in rubber prices was due solely to supply and demand.

What Shall America Do?

Obviously, the way for America to provide for an adequate supply is to grow it herself. Unfortunately the climate of the United States is not one suitable for rubber production, so that it is necessary to acquire plantations in Mexico, the Philippines, Dutch East Indies or West Africa. Perhaps Mr. Firestone's proposal to put some $100,000,000 into his Liberia venture is better known than any other scheme. The probabilities of his plans materializing are small, since his estimates of operating costs are generally regarded as decidedly low, and as such a sum is considerably more than the capital and surplus of his present company. Indeed, it is hardly conceivable that his stockholders would sanction such an undertaking despite its attractions.

Real relief is coming through the United States Rubber Company which has some 124,000 acres or 194 square miles of rubber plantation lands in Sumatra, representing an investment of approximately $25,000,000. In 1925 about 20,000,000 pounds of rubber were obtained from this source and this amount is expected to be increased 75 percent in six years, through new plantings and more mature bearings.

The formation of a $10,000,000, rubber-producing corporation in January by members of the National Automobile Chamber is a forward step toward the solution of the problems at hand. At the same time "The Rubber Association of America" was organized, which expects to expend $50,000,000 over a period of five years in the planting of rubber trees in areas under American control, or where favorable conditions would be assured. Details were lacking at the time of this writing, but as both companies were being organized by leading figures in the rubber industry and had the backing of Secretary Hoover, it is to be assumed that the United States in the future will have a domineering position in the rubber world.

Supply Cannot Meet Demand

The perplexing difficulty of regulating supply so as to coincide with demand is that it takes five or six years for a rubber tree to reach a bearing age. Five years ago production exceeded consumption, prices were low and there was no incentive, therefore, to go ahead with plantings. In 1920 production exceeded consumption by nearly 80,000 tons. In 1924 and 1925 these figures were reversed, consumption exceeding production by about 55,000 tons.

Some idea of the immediate outlook is given in the following estimated figures as compiled by the Rubber Association (in tons).

	Estimated Production	*World Consumption*
1926.....	606,000	575,000
1927.....	623,000	608,000
1928.....	633,000	641,000
1929.....	637,000	672,000
1930.....	641,000	703,000

Rubber is now used in the manufacture of 30,000 articles of commerce, and as new

developments in the industry are constantly taking place, it will be seen that the problem of creating a supply adequate to meet the demand of the future is a serious one.

The shortage in rubber brought forward several interesting measures to alleviate the situation. Old rubber again commanded a market, and junk men were quick to gather in all the discarded tires, hose, boots and rubber goods, which could later be offered for rubber reclamation. Scientists experimented in reclamation processes and a French engineer is thought to have made a practical discovery of importance. His method is to extract pure rubber from worn-out rubber by a new catalyzing process, estimated to cost only 30 francs per ton. As British financial interests are investigating this proposition, we may expect to have its worth promptly demonstrated. An American chemist, not to be outdone, claims he has invented synthetic rubber, which can be derived from various products and even from garbage. After all, something may be developed which can be used to meet a crisis.

To facilitate the trading in crude rubber and rubber futures, the Rubber Exchange of New York, Inc., was organized in January, with a membership of 250, and opened for business on Tuesday, February 2nd. This Exchange operates similarly to the New York Stock, New York Cotton, the Coffee and the Sugar Exchanges. The floor is connected by telephone, telegraph and cable with the leading rubber centers of the world, and the latest information regarding conditions is available to its members. Such an Exchange is a recognition of the world importance of the commodity and its facilities will do much to protect the interests of all concerned. In view of the price of around $1.00 which prevailed for a time, it is interesting to note that the initial sale on the Exchange was for one lot, or five tons of rubber to be delivered in May at 63 cents per pound. The first day's transactions amounted to 60 tons.

Development of Rubber Companies

Unless one is actually a buyer or seller of rubber for business purposes, one will not have much opportunity to deal with the Rubber Exchange. The unit of trading there has been made purposely large to keep out the small speculator. Such persons, or others desiring to interest themselves financially in the industry will find the shares of rubber companies as traded in on the Stock Exchanges more satisfactory to deal in than in rubber futures. Rather complete information, furthermore, regarding the companies' earnings and prospects are available through newspaper and magazine articles and other published reports, so that purchases can be made intelligently. It is also possible to obtain opinions from investment houses.

The development of rubber companies has been from old establishments making iron tires for carriages, just as automobile companies have been organized from former wagon and buggy works. The history of both businesses is closely related, for each has had its periods of great depression and great prosperity. While most motor companies have paid off accumulated dividends and obligations and have established a potent earning capacity, rubber companies are just beginning to bring their financial houses in order. However, rubber concerns have come through the post-war depression period with less wounds than many other industrials. No companies have been actually forced out of business and 1925 earnings and 1926 prospects are such that great optimism reigns.

At one time it was necessary to finance rubber companies with first mortgage bonds bearing usually eight percent coupons and offered to the public at discounts. Features such as high call prices or redemption by lot were added to lend a speculative aspect and so widen the appeal. Those who had faith in the ultimate trend of the business have benefited materially, since these bonds are now quoted at relatively high prices or have been called in for payment through retirement or through refunding at much lower rates of interest. When rubber companies begin to finance improvements or extensions by the sale of common stocks,

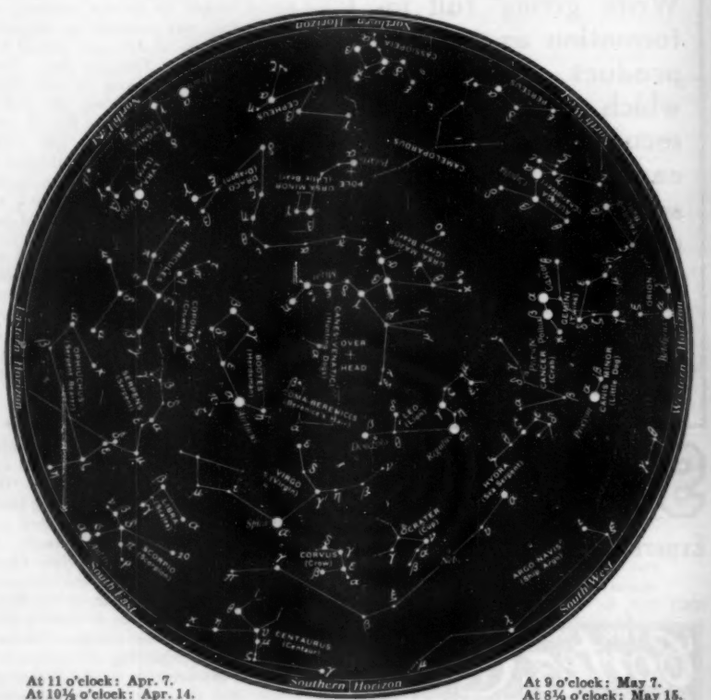
the public will know that the industry is again on a sound basis and that the bonds and preferred stocks are more nearly of investment quality.

Investors must not be fooled by the difference in price of rubber stocks and pick up apparent bargains before investigating them, for this difference is quite likely to be the amount of accumulated dividends thereon. For instance, one company has two 1st Preferred Stocks outstanding. On the same day one stock sold for 112 and the other at 86. This is perplexing until it is known that on one stock there was payable $26 of back dividends, which the holders of the other stock had already received.

The rubber industry is quite essential as a counterpart for the motor industry, aside from its great necessity in providing the various rubber articles, and an intelligent effort is being made to relieve the business of its present hazards. Undoubtedly there is much money to be made in the investment of funds in rubber stocks, both from sizeable dividends and from market appreciation of shares. Those companies which do a diversified business and which are in control of situations from the plantation to the merchandizing of the finished products, would seem to offer the greatest possibilities. Likewise, investors need not decline to invest in the bonds of rubber companies just because they are such a type of bond, for the industry is one of the ten most important ones and essential merchandize is manufactured. A return slightly higher than prevailing rates may usually be obtained from rubber company securities.

The Heavens in April

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.
At 9½ o'clock: April 30.
At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 23.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

The Heavens

IN our usual glance at the sky, we find the Great Dipper high in the north, with Draco below and then Ursa Minor and last Cepheus and Cassiopeia close to the horizon. Lyra and Cygnus are rising in the northeast, Ophiuchus in the east and Scorpio in the southeast. Above them are Hercules, Corona and Bootes. Virgo and Leo are high in the south and southwest, with Hydra and Corvus below. Auriga, Gemini and Canis Minor are well down in the western sky and Orion has just set.

The Planets

Mercury is a morning star all this month, but is best visible towards its close, when he is farthest from the sun, both apparently in degrees and actually in millions of miles. At his greatest elongation on the 28th, he is 27 degrees from the sun—his greatest actual distance, 43,000,000 miles being reached six days earlier.

At this time the planet is in Pisces and rises just before 4:30 A.M., so that he should be easily visible just before dawn.

Venus is also a morning star and at her greatest distance from the sun—46 degrees—on the 18th. She is in the constellation Aquarius and rises at about 3:45 A.M. on the 1st and at 3:15 on the 30th of the month.

Mars is in Capricornus and rises about 2 A.M. He is approaching the earth and growing brighter, but is still more than 130,000,000 miles away. Nevertheless he is as bright as a star of the first magnitude. Jupiter is also in Capricornus and is in conjunction with Mars on the 23d when the two planets are less than a degree apart—Jupiter being to the northward. The morning sky about this time will present a fine spectacle. All the brighter planets will be simultaneously visible, for Saturn is in Libra and crosses the meridian at about 1:30 A.M. on that date.

Uranus is also a morning star, and in Pisces between Mercury and Venus, but is visible only with a telescope—at least in his present unfavorable position. Neptune is in Leo and observable in the evening.

The moon is in her last quarter at 4 P.M. on the 5th, new at 8 A.M. on the 12th, in her first quarter at 6 P.M. on the 19th and full at 7 P.M. on the 27th. She is nearest the earth on the 10th and farthest away on the 22nd. During the month she is in conjunction with Saturn on the 2nd, Mars on the 7th, Jupiter and Venus on the 8th, Uranus and Mercury on the 10th, Neptune on the 21st, and Saturn again on the 29th.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

Inventors are the most interesting people in the world. Their vision, their determination and their hard work are responsible for practically all the progress that mankind has made.

These very qualities which make for success in inventing are the same qualities that often operate to the disadvantage of the individual inventor. The inventor has vision, but he is likely to be visionary. He has determination—and it is a virtue he certainly needs if he is to get anywhere—but he is likely to be obstinate. He is not afraid of hard work, but too often this work is in the wrong direction.

In other words, the inventor is often not a business man, even though his rewards depend at least as much upon business ability as upon the merit of the particular invention. The following item is the first of a series of *Don'ts for Inventors* which we will publish in future issues.

I—Little Things Count

One of the most encouraging things about inventing is that it generally is the simple little ideas, ideas that any of us might have thought of, which make the most money. The husband who watched the tedious efforts of his wife in doing up her back hair and then devised the wire hairpin made a far greater fortune than he probably would have made if he had invented a piece of complicated machinery.

The little invention costs less to manufacture. If you want to sell it outright or license it on a royalty basis, there are a far greater number of prospective buyers than there would be for something that requires elaborate means to produce. Then, too, there is a wider market for the article itself; and although the price may be low, the large volume of business and the repeat customers will usually buy, more than make up for the initial price received for something that is more expensive. *Don't be afraid your invention is too simple to make money.*

Salt Water Taffy

NO little boy would think of leaving the seashore without a bag of salt water taffy. This universal habit is responsible for a business running into the millions of dollars. It is a business which recently was in jeopardy, until the United States Supreme Court came to the rescue.

John R. Edmiston, of Wildwood, New Jersey, in 1923, contended he was the originator of salt water taffy and for ten years prior to 1905 was the only one to manufacture it. The Patent Office registered "salt water taffy" as his trademark.

Edmiston then notified all the other manufacturers of the confection to cease using the trademark and served notice that he would collect royalties on all taffy made since 1895. These royalties would have run into millions.

About 500 candy manufacturers, chiefly along the Atlantic seaboard, joined in the battle against Edmiston. It began in August, 1924. Recently the Supreme Court ruled that the term "salt water taffy" is free to everyone and cannot be registered as a trademark.

Imaginary Mills

WHEN is a mill not a mill? When it is a mill in name only, declares the Federal Trade Commission.

The Western Woolen Mills Company, a corporation of Salt Lake City, has been selling knit underwear, sweaters, hosiery, shirts, blankets and similar merchandise direct to customers in other states. Despite the fact that its agents obtained orders on blanks which read, "I hereby request you to make to order the following goods and ship to me," the company never did own, control or operate any machinery or mill.

When the Federal Trade Commission issued a complaint for the alleged violation of the provisions of the Federal Trade Act, the company changed its name to "Western Woolen & Knit Goods Company." Nevertheless, the Federal Trade Commission went ahead with the case, in order that the law may be made clear, and now declares:

"The practices of said respondent, under the conditions and circumstances described in the foregoing findings, are to the prejudice of the public and of respondent's competitors, and are unfair methods of competition in interstate commerce."

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

ADJUSTABLE FASTENER DEVICE.—Adapted to be used especially in connection with articles of wearing apparel, such as dresses coats or caps. Patent 1565202. H. Reiter, R. 1608, 100 5th Ave., New York, N. Y.

GARMENT SUPPORTER.—A detachable supporting device which may be applied to trousers for gripping the waistband of nether garments. Patent 1566206. C. A. Greene, 1674 Broadway, New York, N. Y.

SUPPORTER.—Of a flexible nature, which can be made to fit any person, and will keep in place without metal staves, straps or bands. Patent 1565429. I. Dodge, 9 Farren Ave., San Francisco, Calif.

UNDERGARMENT.—For women, which is equipped with means for supporting the hose from the shoulders of the wearer, where corsets are not worn. Patent 1568917. Adeline C. Peterson, 556 Breckenridge St., Buffalo, N. Y.

CORSET.—Which may be from time to time adjusted so as to be varied in size throughout or at different sections. Patent 1568909. S. J. Newman, c/o I. Newman & Sons, New Haven, Conn.

PNEUMATIC FOOTWEAR CONSTRUCTION.—By means of which a high degree of resiliency is provided for the heel portion of ordinary type shoes. Patent 1568405. J. C. Keller, 18 E. Elm St., Chicago, Ill.

SHOE STRUCTURE.—Which while closely simulating in appearance a turned-sole shoe, is free from many of the objectionable features. Patent 1569823. F. Maccarone, 908 Kent Ave., Brooklyn, N. Y.

Chemical Processes

UTILIZING SULPHITE CELLULOSE LYE.—As a fuel, by mixing the same with chloride of magnesium and vegetable waste, such as wood chips, and heating to between 150° and 200° C. Patent 1564142. C. G. Schwalbe, c/o F. Schwenterley, Koniggratzerst 59, Berlin S.W. 11, Germany.

LITHOPONE PRODUCT AND PROCESS OF MAKING THE SAME.—Which includes quenching the lithopone in a solution of a soluble alkaline earth salt to form a coating, and then changing the salt into an insoluble one. Patent 1565185. J. L. Mitchell, 17 W. 108th St., New York, N. Y.

PROCESS FOR WEIGHTING SILKS.—Which comprises treating the fabric with solutions of acetic acid, lead acetate, and sodium phosphate. Patent 1565390. A. Pepper, 134 N. 3rd St., Paterson, N. J.

PROCESS FOR TREATING SULPHIDE ORES AND CONCENTRATES.—For extracting the various ingredients in their metallic or salt form in one continuous process. Patent 1566379. M. De Kayser, 113 Park St., Portland, Ore.

Electrical Devices

THERMOSTATIC SWITCH.—Which may be utilized as a flasher or for any other purpose within a circuit to be automatically opened and closed, and in which a twisted flexible device supports a circuit breaker and is caused to move to open and closed position at an expansion and contraction of its support. Patent 1561425. H. R. Fernandez, 14 Villegas St., Havana, Cuba.

STORAGE BATTERY.—Having a spacer attached to each of the positive plates, to provide room for the active material that falls. Patent 1564163. E. H. Williams, 486 Schoonmaker Ave., Monessen, Pa.

LAMP SHADE FRAME.—For electric fixtures, such as bed lamps, which will not require the removal of the cord from either the socket or attaching plug. Patent 1564,170. K. C. Berger, 367 1st Ave., New York, N. Y.

ELECTRIC IRON.—Adapted to iron materials of delicate texture, such as velvets, satins, etc., but may be used as an ordinary iron. Patent 1563591. A. Ruelland, c/o Miss Pugh, 5 E. 68th St., New York, N. Y.

CIGAR LIGHTER.—Having an electrical heating circuit, closed when the lighter is pulled forward toward the smoker. Patent 1564072. J. M. Jackson, c/o Rope & Cordage Co., Parkersburg, W. Va.

RADIO COIL MOUNT.—Especially adapted for adjustably supporting radio-active elements for obtaining more perfect selectivity and volume in tuning operations. Patent 1565206. G. F. Ruzicka, Bohemia, N. Y.

METHOD OF DETECTING THE PRESENCE AND APPROXIMATE LOCATION OF METALLIC MASSES.—A device including moveable balanced ground antennas for determining direction of signals and locating metals. Patent 1564940. F. S. Chapman, c/o M. Y. Furney, Kenton, Ohio.

RADIODOLL.—Within which is supported a part or all of a complete radio apparatus, capable of ready manipulation. Patent 1565145. B. L. Henry, Imperial Hotel, 31st St. and Broadway, New York.

ILLUMINATED DIAL.—For radio apparatus, wherein the dial may be illuminated without illuminating the surrounding objects to any appreciable extent. Patent 1566069. W. C. and F. Bucholz, 87 Penn St., Brooklyn, N. Y.

ILLUMINATING ATTACHMENT FOR MUSICAL INSTRUMENTS.—For pianos or similar instruments, by means of which the flashing of illuminating means coincides with the rhythm of the music. Patent 1566202. H. A. Giller, 90 Maurice Ave., Elmhurst, N. Y.

ELECTRICAL SWITCH.—For use in many different ways, but particularly adapted for giving direction indicating signals in connection with motor vehicles. Patent 1563,753. C. R. Krone, 410 28th St., Oakland, Calif.

DRY BATTERY.—In which the electrodes and the electrolyte are rendered active only when the battery is withdrawn from its container preparatory to use. Patent 1566927. D. Rosen, deceased, address Mrs. B. Rosen, Box 1, Ave. "K," Brooklyn, N. Y.

SWITCH-OPERATING DEVICE.—By means of which the electric lights in a sleeping room may be turned on simultaneously with the operation of an alarm clock. Patent 1567,104. M. J. and C. L. Beck, Route 3, St. James, Minn.

THERMOSTATIC CONTROL.—For an electric circuit that will automatically maintain water heaters, glue kettles and similar devices at a desired temperature. Patent 1566,699. E. A. Scholtz, 4055 19th St., San Francisco, Calif.

ELECTRIC AERIAL ADVERTISING MEANS.—In which an advertisement is suspended from a balloon having a revolving movement, the sign being visible from all points. Patent 1568011. C. S. Trippeda and A. J. Dichiaro, c/o Daylo Electric Light Co., 40 E. 2nd St., New York, N. Y.

RADIODIAL.—Having an attachment by means of which stations are so recorded as to facilitate the tuning in of the set. Patent 1567963. J. Lupo, Jr., 3636 Park Ave., Bronx, N. Y.

FIRE-ALARM-SIGNAL-TRANSMITTING APPARATUS.—In which whenever a fire alarm signal is sent over a circuit, a wireless signal

American "Open Door" Policy

THE strong contrast between the policy of British manufacturers who so often refuse to disclose their processes and that of American firms is well demonstrated by the following note in a recent report of the Bureau of Mines. Says *The Engineer:* "The rapid stride in flotation concentration, it is noteworthy to point out, is due to the freer exchange of facts and data by the staffs of the larger mining companies and the patent controlling corporations, and by investigators in general. Generally speaking, one may visit any mining plant and by presentation of proper credentials be shown all that is going on or that is being done."

Yankee Brands in the Sudan

CIVILIZATION follows the trademark. The truth of this is impressed upon us by the registration of two marks just made in the Sudan, Northern Africa, by American firms.

One of these firms is the Transcontinental Oil Company, of Pittsburgh, which registers its widely known trademark "Marathon" for petroleum, kerosene, gasolene, lubricating oils and similar products. The other is the Bucyrus Company, of South Milwaukee, which registers "Bucyrus" for steam shovels, locomotives, pile drivers—machinery of all kinds, in fact.

Sudan trademark procedure is simple. A man simply registers his mark and it is published in the Sudan Government *Gazette* in both English and Egyptian. This serves as public notice of his ownership, and infringers act at their peril.

The Courts Aid the Canvasser

YOU probably are familiar with the canvasser who calls at your home and tries to sell you a colored enlargement of a photograph of one of the family. But did you know that he represents a gigantic industry and that the Federal Trade Commission has tried in vain to put an end to the hokum in his sales talk?

The case in which the Circuit Court of Appeals in Chicago renders a decision is that of the Chicago Portrait Company. The Federal Trade Commission ordered the company to cease representing falsely to customers that they were getting cut prices. The portrait company appealed to the courts. Judges Evans and Page, in the majority opinion, vacate the Trade Commission's order and say:

"The purchaser might have been deceived in some small way, but certain it is that he was not injured, nor was any competitor injured. From the forbidden acts there seems to us no possibility of injury to competitors, and we are of the opinion that they are neither within the letter nor the spirit of the act."

is also transmitted. Patent 1567326. A. P. Loper, P. O. Box 496, Palmer & Water Sts., Stonington, Conn.

PERMUTATION SWITCH LOCK.—For electric switches, necessitating the operation in a predetermined sequence of a group of elements, thus make the closing practically impossible by unauthorized persons. Patent 1568483. J. J. Tolbert, 577 North Kenmore Ave., Los Angeles, Calif.

Of General Interest

COMBINATION SINK STOP AND DRAIN.—Eliminates the dish pan, and many other utensils. Patent 1511018. Jacob Binder, 159 Moore St., Ludlow, Ky.

MOLD-FORMING DEVICE.—In which the cast article will have a smooth appearance, for casting precious metal, articles of jewelry and the like. Patent 1563189. G. A. Hausherr, c/o Mr. Bolder, Bennington St., Newark, N. J.

NEEDLE THREADER.—Whereby the needle when dropped into the device, will automatically seat itself in proper position to receive the thread. Patent 1563223. W. Parsons, 631 Green Ave., Brooklyn, N. Y.

PROCESS OF PRODUCING COLOR-FILLED EMBROIDERED DESIGNS ON TEXTILE FABRICS.—Which does away with the use of the pantograph for producing the outline, the design being reproduced in any length or quantity. Patent 1563185. P. Gouled, c/o Independent Mfg. & Importing Co., 225 5th Ave., New York, N. Y.

WINDOW SCREEN.—With means for adjustably securing the same to provide for any desired degree of raising or lowering the window. Patent 1563361. M. F. Henning, 5732 E. 14th St., Oakland, Calif.

SOLAR ATTACHMENT FOR TRANSITS.—Capable of carrying out all the operations and observations which may now be achieved, without necessitating a series of delicate adjustments. Patent 1563484. J. M. Gunn, Laguna, New Mexico.

STAMP HOLDER.—Designed primarily for use by rural mail offices, for preventing sticking of the stamps in damp or warm weather. Patent 1563686. M. B. Bultman, 261 Broad St., Sumter, S. C.

POST BASE.—For protecting from decay the part of a post which is near the ground and most liable to rot. Patent 1564109. L. Ponsolle, Angers, Maine-et-Loire, 16 Rue de Bel Air, France.

SASH LOCK.—Establishing an adjustable locking connection between the upper and lower sashes whereby the same may be retained partially open. Patent 1564128. R. Curtis, Sr., 384 Princeton Ave., Jersey City, N. J.

TOOTHBRUSH RACK.—Which will support a maximum number of brushes in a minimum of space and maintain the bristles out of contact. Patent 1564119. J. H. Balmer, 259 Plane St., Newark, N. J.

SAMPLE DISPLAY FOLDER.—Of book-like structure, having a display frame adapted to overlap any one of a plurality of sample fabrics. Patent 1564152. J. M. Thomson, c/o Sherman & Sons, 381 4th Ave., New York, N. Y.

REPLACEABLE TOOTH.—Whereby a porcelain tooth, and a backing, may be easily and firmly united. Patent 1564087. W. L. Mason, c/o George R. Lamb, 414 1st National Bank Bldg., Cincinnati, Ohio.

CHIMNEY PROTECTOR.—For protecting the chimney top against weather conditions, and reinforcing the top layers of bricks. Patent 1563706. S. A. Hoffland, Box 624, Fennimore, Wis.

PAPER CONTAINER.—Which will allow the use of heavy cardboard, and yet make the end member practically an integral portion of the body. Patent 1563063. G. H. Bartlett, 1648 21st Ave., San Francisco, Calif.

HOLDER FOR BAKED APPLES.—With means for holding the individual apple while it is being baked, the apple being served on the holder. Patent 1565077. M. G. Finn, 1822 E. 23rd St., Brooklyn, N. Y.

ADJUSTING LOOP.—More specifically a clamping device for ropes and cables, which permits of ready adjustment, yet rigidly holds against accidental slipping. Patent 1565041. F. J. Arney, 423 E. 162nd St., New York, N. Y.

PHONOGRAPH STARTING AND STOPPING DEVICE.—So constructed that the phonograph may be automatically started by an alarm clock, and stopped as soon as the record is completed. Patent 1565158. L. Jurenka, 1288 1st Ave., New York, N. Y.

INCINERATOR.—For safely holding papers or other waste material while they are being burned, the device is constructed of woven wire. Patent 1565120. J. W. Thompson, 15 Terrace Ave., White Plains, N. Y.

CANOPY HOLDER.—Of the knockdown foldable type, which will serve to support a canopy of mosquito netting over a bed. Patent 1565191. V. P. Nelson, 264 Lexington Ave., New York, N. Y.

SIPHON.—Having a flexible tubular member whereby a flow of liquid therethrough is obtained in a quick and positive manner. Patent 1564630. R. Saa, Box 306, Station "A," Auburn, Calif.

KNEE OR FOOT REST FOR SHOVELS AND THE LIKE.—Providing a rest by which the weight of the operator can be applied in forcing the blade into the earth. Patent 1563528. S. Rubio, 920 Sunset Blvd., Los Angeles, Calif.

DRAFTING TABLE.—For students in home use, the table being so made that it can be readily taken apart and packed into as small a space as an ordinary suitcase, an adjustable T-square is also included. The inventor has been granted two patents, 1564358 and 1564359. P. Klein, 181 Glessner Ave., Mansfield, Ohio.

WALL BOARD COMPOSITION.—For use in building constructions, and as a substitute for wood in furniture production, the composition comprising sawdust, sodium silicate, whiting and molasses. Patent 1564706. J. W. Oelhafen, Tomahawk, Wis.

SMOKING SET.—Combining receptacles for a package of cigarettes, book matches, and smoking refuse, adapted for use in automobiles or other vehicles. Patent 1566139. J. A. Honegger, 2030 Palmetto St., Brooklyn, N. Y.

SPACING FASTENER FOR WIRE SCREENS.—Used as reinforcing elements for cement mixtures applied to the face of a house of stucco finish. Patent 1563785. I. Paterson, 1904 Ashby Ave., Berkeley, Calif.

SCAFFOLD HORSE.—Of knock-down adjustable type, having interlocking parts of tubular cylindrical form, easily moved from place to place. Patent 1566171. W. J. Spurr, 322 Crescent Ave., Leonia, N. J.

KEY HOLDER.—Which is extensible, having an attaching tab applicable either to a button or belt, and in normal condition of comparatively short length. Patent 1566192. A. J. Forrest, c/o Ohio Express, 603 N. Dearborn St., Chicago, Ill.

AUTOMATIC WAKE-UP DOLL.—Which when placed in its crib the eyes will remain closed for a suitable length of time, and will then automatically open. Patent 1566166. G. H. Parsons, c/o Averill Mfg. Co., Wales Ave. and 143rd St., Bronx, N. Y.

SADIRON HOLDER.—Which will properly grip the handle of the iron, and effectually protect the hand of the user. Patent 1566933. H. Toepfer, Everglade Ave. and Mohawk St., Little River, Fla.

HAIR-TRIMMING GUIDE.—Whereby to insure a uniform shaping and cutting of the hair around and in front of the ears. Patent 1567011. J. Parziale, 8714 111th St., Richmond Hill, N. Y.

WATCHCASE CONSTRUCTION.—Forming a diversified setting in which the dial of a watch movement may be displayed. Patent 1566976. D. Schmidt, 114 Fulton St., New York, N. Y.

DOLLS' EYES.—Of the moving type, which are self-sustained within the head without the use of plaster of Paris. Patent 1566908. L. H. Messinger, Jr., 198 Flanders St., Bridgeport, Conn.

FLEXIBLE CEMENT COMPOSITION.—Comprising eight parts of sand, four of cement, four of a calcium soap, and one of a zinc soap, forming a paint or plaster. Patent 1566917. O. Olesen, 370 Wadsworth Ave., Apartment 24, New York, N. Y.

SWIMMING RING.—In the form of a hollow and inflatable construction with a head representing a swan or other fowl. Patent 1566858. E. A. Guinzburg, 302 Fifth Ave., New York, N. Y.

SPRINKLER HEAD.—Which is adjustable for the purpose of varying the area of lawn sprinkled, and the control of water pressure. Patent 1564587. J. Kreiziger, 2217 W. 31st St., Los Angeles, Calif.

SIPHON.—Whereby liquid can be siphoned without the usual necessity of applying the mouth to the tube to start action. Patent 1566916. T. Okihara, 50 N. Beretania St., Honolulu, Territory of Hawaii.

TOOTHBRUSH HOLDER.—Wherein a plurality of tooth brushes are suspended and protected when not in use, but may be readily removed. Patent 1566860. J. P. Hainzigianis, c/o Cutting, Phillips & Hale, 25 Broadway, New York, N. Y.

SCREENING DEVICE.—Which can be readily applied to and securely held in ventilating openings without the use of nails, screws or like fastenings. Patent 1564365. A. A. Newnham, 107 Bath St., Santa Barbara, Calif.

AWNING.—In which the canvas may be drawn from one side of the window to the other, permitting ventilation and obstructing the sun's rays at various hours. Patent 1566116. E. Poulsen, 625 Milwaukee Ave., Chicago, Ill.

TOE SLIPPER.—Of the type used by ballet dancers, made with a re-enforcing member at its toe to sustain the weight of the body on the toe. Patent 1564607. G. Meier, 818 Eastwood Ave., Chicago, Ill.

CUFF BUTTON.—Having two cooperating parts and novel means for causing the cooperating members to become released, the parts are entirely encased. Patent 1564657. G. Wullum, 1733 N. Francisco Ave., Chicago, Ill.

SIPHON.—By means of which a siphon action may be readily started and controlled, in discharging the contents of a bottle or jar. Patent 1566753. P. H. Kraetch, Astoria, Oregon.

DRAFTSMAN'S POUNCE BLOCK.—For preparing the surfaces of drawing or tracing cloth before working thereon, and preventing the pounce powder from flying. Patent 1565670. F. Philip, Lompoc, Calif.

ADVERTISING DEVICE.—Which has movable members adapted to be actuated by the wind to attract the attention of passersby. Patent 1566739. H. R. Estes, c/o Mrs. S. A. Dinwiddie, 7206 Lanhar Ave., St. Louis, Mo.

METHOD OF MAKING PORCELAIN ARTICLES.—By which the production will be cheapened by the saving of time and labor, on an accurate and perfect product. Patent 1566841. E. L. Dillman, 42 Flushing Ave., Jamaica, N. Y.

HOLDER FOR THERMOS BOTTLES AND THE LIKE.—Readily mounted in any suitable place for the support of a thermos bottle in an upright position. Patent 1566698. L. Saiger and M. Russell, Johnstown, N. Y.

CONCRETE SHINGLE.—Which can be secured firmly in place in association with other shingles to produce a fireproof and leakproof roof. Patent 1567946. C. F. Helfinger, Box 505, Hobart, Wash.

Hardware and Tools

A BURGLAR PROOF SAFETY LOCK COMPRISING A MOVABLE PORTION AND A WEDGE SHAPED KEEPER.—Improved model. Patent 1487328. Max Golden, c/o Wachs Bros., 35 Bleecker St., New York City.

SAW.—Made of stock material, and minimum number of parts, assembled and disassembled in the simplest manner. Patent 1564105. A. F. Ouellet, 106 W. 86th St., New York, N. Y.

DOOR HOLDER.—Adapted to be actuated automatically to hold a door in open position until manually released. Patent 1563795. W. Roberts, R. D. No. 9, Springfield, Ohio.

SCREW JACK.—Employing ball bearing screws, reducing friction to a minimum, and which made with a smaller lead, develops more power than ordinary jacks. Patent 1565805. H. H. Jones, 20 E. Cota St., Santa Barbara, Calif.

WRENCH.—For nuts, bolts or pipes, having a special form of adjusting worm which ensures proper engagement with the rack bar. Patent 1564411. J. H. Fones, 1822 E. 23rd St., Brooklyn, N. Y.

LATCH.—Of simple form, by means of which a door can be opened merely by pushing on the knob, without turning it. Patent 1565212. J. Sillick, 52 E. 129th St., New York, N. Y.

DOOR CONTROL.—Which will act automatically to hold a swinging closure in any desired position, it is practically noiseless in operation. Patent 1565524. W. B. Summerall, Box 2113, Atlanta, Ga.

TOOL-HOLDING DEVICE.—Adapted to be attached to the pocket of a garment for releasably securing tools and preventing their accidental removal. Patent 1566195. N. E. Gandrau, 408 E. Grand Ave., Watts, Calif.

UNDERREAMER DRESSING BLOCK.—For holding an underreamer cutter in a perfectly upright rigid position without damage to the original form. Patent 1566483. G. E. Kraeer, Box 548, Wilson, Okla.

COMBINATION LOCK.—In which a plurality of tumblers is required to be arranged in a given order to permit the lock to be opened. Patent 1566829. F. Clark, Calle Juarez 35, Durango 3, Mexico.

AWNING ATTACHMENT.—For elevating or lowering awnings, so constructed that it may be operated from inside of a room. Patent 1566450. W. A. Tomlinson, Phoenix, Arizona.

DOOR BOLT.—Adapted to be carried by the door and engage the floor to positively prevent the opening of the door. Patent 1566,805. B. Ackerman, 144 W. 19th St., New York, N. Y.

LOCK NUT.—Which insures the locking of the bolt but provides for convenient release of the locking means when desired. Patent 1566830. F. Clark, Calle Juarez 35, Durango 3, Mexico.

HAMMER.—In which an insert is provided for re-enforcing the handle at the head, preventing shrinkage and providing greater strength. Patent 1565068. M. Nicholis, c/o M. J. Wolcott, Exeland, Wis.

COMBINATION LOCK.—Of comparatively simple construction, in which means is provided for readily permitting the changing of the combination. Patent 1566884. R. Larosa, 463 Catherina St., Ft. Lee, N. J.

ROOF FLASHING.—Which can be quickly applied, requires no nails or lath, prevents leakage, and adds to the life of the roof. Patent 1566750. W. Jacobson, 2011 W. Division St., Chicago, Ill.

SOCKET OR SPEED WRENCH.—In which yielding means are introduced in the socket tending to force the nut acted upon outwardly. Patent 1566700. C. B. Michel, Oakland, Calif.

PLASTERING STAPLE.—Adapted to function as laths or furring strips for spacing the plaster receiving wire mesh from the sheathing. Patent 1566747. C. Holloway, Jr., 950 Bryant St., San Francisco, Calif.

OVERSHOT.—Designed to use cement for the purpose of binding the object being recovered from a well, yet provide convenient removal of the object when above ground. Patent 1567109. A. Boynton, c/o Frontier Oil Co., City National Bank Bldg., San Antonio, Texas.

LOCK.—In which there is provided a key operated series of tumblers and a pawl operated series of tumblers. Patent 1567979. C. E. Northrop, deceased, Clara L. Northrop, Administratrix, 419 Highland Ave., Dayton, Ohio.

DOORKNOB.—In which is incorporated as a central element, a mirror, protected against knocks or blows. Patent 1567954. S. Kalm, c/o J. Chester Sons Co., 145 Grattam St., Brooklyn, N. Y.

Heating and Lighting

WATER HEATER.—Which may be connected to a domestic boiler for quickly heating the water by means of a gas burner. Patent 1566209. J. G. Haus, P. O. Box 35, Weirton, W. Va.

METHOD OF HEATING HONEY.—By causing the honey to travel in a thin sheet while subjected to 156 degrees for a brief period, then rapidly cooling the same. Patent 1565471. A. G. Kuykendall, La Mesa, Calif.

OIL BURNER.—Having means for vaporizing the oil and forcing the vapor through a very small orifice, whereby the roaring of the burner is eliminated. Patent 1564571. M. Herod, R. F. D. No. 4, Michigan City, Ind.

GAS LIGHTER.—In the form of an attachment for gas stoves and comprises a pilot light and main burner with cut off for both. Patent 1567962. C. M. Lee, 205 Pasadena Ave., Elyria, Ohio.

STOVE BURNER AND WATER HEATER.—So combined that water may be boiled while the usual cooking operations are carried out, without the delay incident to separate operations. Patent 1568853. J. P. Lane, 171 Clinton St., New York, N. Y.

AIR HEATER FOR FURNACES.—Wherein heated air may be supplied above the bed of coals in the furnace, and may be readily regulated. Patent 1569811. E. Jordan, 1634 132nd St., Richmond Hill, N. Y.

Machines and Mechanical Devices

TENSION DEVICE FOR SHUTTLES.—Which begins to function automatically as soon as the thread is placed in operative position, providing the desired tension. Patent 1565,187. C. F. Moore, c/o Schwarzenback Huber Co., Bergenline Ave. and Oke St., West Hoboken, N. J.

SMOKING SET.—Constructed in such manner that a single cigarette and a single match will be discharged upon the operation of mechanism. Patent 1566175. J. Vaghi, Bethel, Conn.

MACHINE FOR CUTTING BUTTON BLANKS. So constructed that it will be possible to use thereon shells of concavo-convex form. Patent 1558254. P. F. Dusha, A. Feyk, and E. Feyk, c/o V. F. Nekarda, 230 Fifth Ave., New York, N. Y.

STAPLING MACHINE.—For shoe manufacturers, having means for drawing the leather tight over the last as the staples are inserted. Patent 1563435. A. H. Prenzel, Halifax, Pa.

BEAM TENSION DEVICE FOR KNITTING MACHINES.—Capable of adjustment to any desired tension, and automatically maintained at that tension while the machine is in operation. Patent 1564162. O. C. Wiese, 1765 E. 19th St., Brooklyn, N. Y.

AUTOMOBILE PARKING MACHINE.—By means of which a minimum of ground space is required for the accommodation of a large number of cars. Patent 1564100. J. E. Morton, 5 Murdock Apts., West Lafayette, Ind.

CAM BOX FOR KNITTING MACHINES.—In which the cams are so arranged that the needles will work lower in respect to the sinkers, without damaging either. Patent 1563788. J. P. Primm, c/o Rome Hosiery Mills, Rome, Ga.

COOLING MACHINE.—For use in the process of engraving, in what is called the burning-in step of an etching process. Patent 1560640. A. H. Antz, c/o Sierra Art & Engraving Co., San Francisco, Calif.

GUMMED-TAPE-SEALING MACHINE.—In which tape having an adhesive surface is drawn from a roll and moistened and torn off in suitable lengths. Patent 1563209. J. H. McIntire, 276 Jefferson Ave., Brooklyn, N. Y.

WIRE STRETCHER.—For pulling wire screening taut when applying to windows or doors. Patent 1565065. J. B. Doerr, 109 W. Washington St., Orlando, Fla.

OIL AND GAS SEPARATOR.—For collecting and separating the gas from the oil as the commingled gas and oil come from the well. Patent 1565135. C. J. Wolfe, Yale, Okla.

POWER TRANSMISSION MECHANISM.—Particularly adapted for use with portable well drilling apparatus, driving the mechanism necessary in spudding in, drilling, casing application, and baling. Patent 1563514. J. W. Miller, 311 North Raymond Ave., Pasadena, Calif.

CUTTING MACHINE FOR PRINTING PRESS ROLLERS.—Which operates to simultaneously trim the ends, and circumferentially grooves the roller for dividing the surface. Patent 1566184. C. M. Earley, 321 86th St., Brooklyn, N. Y.

REGULATING VALVE FOR FLUID-PUMPING APPARATUS.—Which can be inserted in an ordinary pipe line between a liquid container and a pumping apparatus. Patent 1566147. C. S. Lens and G. E. Jupp, c/o American Marine Devices Corp., 400 W. 23rd St., New York, N. Y.

AUTOMATIC CONTROL WINDING MECHANISM FOR CLOCKS.—Adapted to wind the clock without interference with the normal operation, the winding being electrically operated. Patent 1565705. J. M. Boner, 225 Main St., Evansville, Ind.

EVENNESS TESTER.—For testing thread, yarn and the like, so that the weaver may know in just what portions the unevenness occurs. Patent 1569949. H. S. Wyckoff, 316 Hudson St., New York, N. Y.

RATCHET MECHANISM.—Which is automatic in operation, and is particularly well adapted for use in reversible ratchet wrenches and the like. Patent 1565473. W. R. Lee, 1819 Main St., Galena, Kans.

AUTOMATIC DISPENSING DEVICE.—For liquids, set in operation by the opening of a valve which will cause the operation of a motor for driving a pump. Patent 1566591. C. A. Goldsmith and J. F. Montague, Collingswood, N. J.

WATER MOTOR.—In which revolubly mounted blades, against which a stream is directed to the upper portions, causes a whirl pool effect. Patent 1566725. C. A. Blume, c/o Whirl Pool Water Motor Co., Rocky Ford, Colo.

LIFT FOR GIN BREASTS.—Which may be readily operated either by hand or foot, may be readily held in locked position or easily released. Patent 1567185. F. B. Cumpston, Blooming Grove, Texas.

LIQUID VENDING MACHINE.—Having a coin-control mechanism, forming part of a pump, for dispensing a predetermined quantity of gasoline or other liquid. Patent 1567888. W. D. Ambrose, Nacogdoches, Texas.

OPERATING MEANS FOR PRINTING PRESSES.—Comprising an arm adapted to fall by gravity and initiate the operation of any ordinary press, and particularly the D roller type. Patent 1568015. J. A. and J. Williams, 23 Mt. Prospect St., Belleville, N. J.

DRILL PULLER.—Adapted to be applied to a drill rod for pulling the same when jammed, by utilizing the rotational movement of the rod. Patent 1567504. G. Hinman, Box 137, Jerome, Arizona.

WATCH.—Which will be substantially dustproof, and present a minimum number of parts thus being inexpensive to manufacture. Patent 1568003. A. C. Smith, c/o Elgin Watch Co., 20 W. 47th St., New York, N. Y.

DISHWASHING MACHINE.—Wherein the dishes are moved through the washing solution with both circular and up and down movement. Patent 1567992. S. and H. G. Dyktor, 813 No. Vista St., Los Angeles, Calif.

LIQUID VAPORIZER AND DISTRIBUTOR.—For use with fans, by means of which air ducts compel a flow of air through a liquid container. Patent 1567957. M. B. Kesselman, c/o Amtorg Trading Co., 165 Broadway, New York, N. Y.

RUBBER FRICTION DRIVE RING.—Having a special split joint whereby the ring may be renewed easily and quickly without stripping the shaft. Patent 1566704. G. M. Stevens, San Francisco, Calif.

LINEN CUTTING MACHINE.—For holding cloth, along a warp or weft thread, and making a straight cut with a power driven cutting member. Patent 1568592. H. J. Fellman, 1418 W. 2nd St., Hastings, Neb.

Medical and Surgical Devices

PROCESS AND PRODUCT FOR PREVENTING RUST.—In sterilizing surgical instruments, the bath comprising a weak solution of sodium nitrite and sodium sulphate. Patent 1565043. B. D. Avis, Box 130, Clarksburg, W. Va.

COMBINATION MEDICAL APPARATUS.—For realizing the beneficial effects of light and heat, in a so-called electric light bath, the device can be folded for storage. Patent 1563736. C. B. Fink, Hotel Morton, San Francisco, Calif.

TOURNIQUET.—That may be conveniently carried in the pocket, having special means for quickly twisting and fastening the same in twisted form. Patent 1566235. J. H. Sheehan, 663 7th Ave., Astoria, L. I., N. Y.

DEVICE FOR AIDING THE HEARING.—By means of which a person normally deaf, may be treated so that they may hear for the duration of the treatment. Patent 1566731. C. Carrol, Box 502, Chicago, Ill.

METHOD OF MAKING DENTAL PLATES.—Particularly porcelain plates, whereby the finished article may be readily removed from the mold without damage to the plate. Patent 1566840. E. L. Dillman, 42 Flushing Ave., Jamaica, N. Y.

RUPTURE PAD.—So constructed that its use will exercise the rupture and stimulate the same to a degree which will promote a healing. Patent 1568932. S. O. Trescott, P. O. Box 255, Battle Mountain, Nev.

Prime Movers and Their Accessories

STEAM ENGINE.—Which is flexible and reversible in operation, controlled by simple valve mechanism, and produces a maximum power from the motive fluid utilized. Patent 1564137. J. H. Livingston, Girard, La.

STEAM ENGINE.—In which a lever is within reach to change from full stroke to cut off, and the number of bearings is reduced and there are both economy and facility of operation. Patent 1566201. C. R. Gibson, c/o J. F. Brunning & Sons, 10 Upper 1st St., Evansville, Ind.

GAS ENGINE.—Having a combustion chamber between a pair of opposed pistons which through rock levers and links operate a single crank shaft. Patent 1566843. R. E. Du Be, 259 Galopago St., Denver, Colo.

IGNITION SYSTEM.—Which causes distribution of the secondary current from a single coil to the spark plug of the Ford ignition system. Patent 1566888. G. Luckeman, Hoboken, N. J.

PISTON.—Provided with a follower and fastening means therefor which will effectively prevent leakage of steam beneath the follower. Patent 1566931. A. Tickle, Standish Arms, 169 Columbia Heights, Brooklyn, N. Y.

CENTRIFUGAL VAPORIZER.—Reducing a mixture of air and fuel, to a fine mist which will burn rapidly and completely in the combustion chambers. Patent 1566862. J. R. Halterman, Cairo, Ill.

HYDRAULIC POWER TRANSMISSION.—In which the driving engagement of one shaft with another may be effected gradually with a cushioning effect, eliminating jolts. Patent 1568394. V. Arkin, 2638 W. Davison St., Chicago, Ill.

ROTARY ENGINE.—Which insures a maximum utility of the expansive action of steam between the stationary abutment and a rotor connected with a driving shaft. Patent 1569791. J. W. Shepard, Box 344, Tucson, Arizona.

Pertaining to Vehicles

OIL GAGE.—Which may be manipulated for observation of the oil level from a point on the outer side of the running board shield. Patent 1564535. E. Davis, 324 Roosevelt Ave., Syracuse, N. Y.

AUTOMOBILE LOCKING DEVICE.—Whereby a plurality of levers may be quickly locked to prevent operation and the device readily removed when not in operation. Patent 1566885. M. Laska, 1700 Tulane Ave., New Orleans, La.

BUMPER PROTECTOR CUSHION.—For association with any ordinary type of vehicle bumper, to prevent scratching or mutilating parts of other vehicles. Patent 1566839. R. Denels, 675 5th Ave., New York, N. Y.

REFLECTOR FOR HEADLIGHTS.—Constructed to give full illumination yet at the same time so diffuse the light as to prevent glare. Patent 1566906. C. and A. Matisse, 207 E. 133rd St., New York, N. Y.

AUTOMOBILE BED.—Of a foldable nature, readily adapted for use upon an automobile for camping purposes. Patent 1566612. E. V. Loustalot, Franklin, La.

AUTOMOBILE BUMPER.—Which is unusually resilient, while at the same time the construction is strong, and will not sag. Patent 1566991. J. Sonnenfeld, 22 Tompkins Ave., Brooklyn, N. Y.

TRACTOR ATTACHMENT FOR BURNING IN BEARINGS.—Which will afford facilities for making use of the motive power of the tractor to burn in the bearings of a motor. Patent 1561964. R. C., H. F. and E. A. Whittman, 424 Parade St., St. Marys, Pa.

CURTAIN LIGHT.—Particularly relating to a frame for securing the glass, whereby the frame and light are effectively held in a vehicle curtain. Patent 1562356. E. Mandel, 461 Central St., Brooklyn, N. Y.

ENDLESS RUNNER FOR MOTOR TRUCKS.—Adapted for use with motor cars of every character, wherein an oblong or elliptical form of structure is provided. Patent 1561,996. E. M. Perry, 649 Market St., Youngstown, Ohio.

AUTOMOBILE.—With quick stopping mechanism, for preventing accidents, the device being automatically operated by contact with an object, or manually operated. Patent 1563214. S. S. Maran, 168 W. 96th St., New York, N. Y.

TRAILER.—Which affords facilities for resiliently supporting a load above the axle so that no zig-zag movement will be caused. Patent 1562652. W. C. Nabors, Mansfield, La.

CONVERTIBLE BODY FOR AUTOMOBILES.—Readily converted from an open to a closed type, and wherein the glass panels are firmly supported in the closed type. Patent 1563,023. P. H. Gaskins, 1207 Graham Bldg., Jacksonville, Fla.

MECHANICAL GLARE DARKENER FOR AUTOMOBILE HEADLIGHTS.—A manually operated shutter which will permit of sufficiently covering the fronts of the lights to prevent glare. Patent 1563297. T. J. Shonley, Box 326, Mount Ayr, Iowa.

AUTOMOBILE HEADLIGHT.—Which will direct the rays forwardly and downwardly, so as to illuminate the road while preventing danger from glare. Patent 1563656. M. P. E. Radloff, Hustisford, Wis.

TIMER.—In which the brush consists of a single piece of wire bent into a spiral, with novel means for advancing or retarding the spark. Patent 1563703. H. W. Gossell, Verndale, Minn.

NEUTRAL LATCH FOR PLANETARY TRANSMISSION.—By means of which unintentional movement of the foot pedal to low speed position, is entirely precluded. Patent 1563,778. R. E. Mudd, 715 E. 61st St., Chicago, Ill.

AUTOMOBILE SIGNAL.—Which may be connected to the windshield and be visible to those in the front or rear, either day or night. Patent 1564123. M. P. Clough and N. H. Noyes, Box 113, North Haverhill, N. H.

SEAT SUPPORT FOR TRACTORS.—Adapted for use on the "Fordson" without dispensing with the seat supporting spring usually employed. Patent 1563824. E. C. Bachman, R. D. No. 1, Box 949, Santa Ana, Calif.

TOW ROD.—In sectional form whereby it may be easily and conveniently carried as part of an automobile equipment. Patent 1563860. J. Jacobson, R. 1, Box 50, Columbia Falls, Mont.

GAGE.—Having accurate means to indicate the pressure within a tire, and means for automatically relieving excessive pressure. Patent 1563847. G. H. Hall, address D. D. Bell, Spreckles Bldg., San Diego, Calif.

TESTING AND TRUING DEVICE.—Especially designed for testing and truing connecting rods of the engines of motor vehicles, automobiles or the like. Patent 1563939. J. C. Taylor, Hermansville, Mich.

TIRE COVER.—Comprising a casing made to conform to the outlines of the tire and split transversely to be adapted to be sprung on. Patent 1563760. M. B. Loetscher, 727 Bedford Drive, Beverley Hills, Hollywood, Calif.

DIRECTION SIGNAL FOR MOTOR VEHICLES.—In which any one of a plurality of indications can be given, visible from the front or rear, and selectively illuminated. Patent 1563494. E. A. Jensen, 726 De La Vina St., Santa Barbara, Calif.

ARRANGEMENT FOR PARKING VEHICLES.—Which allows of the greatest possible number of motor vehicles being parked in a minimum of space. Patent 1563929. F. E. Reinhold, 7470 Clinton St., Los Angeles, Calif.

VEHICLE BODY.—In which the fenders are an integral part of the body, and the foot boards are eliminated, no portions projecting from the body. Patent 1563803. R. L. Southern, Oakland, Calif.

TIRE MOLD.—Readily assembled and disassembled, for vulcanizing pneumatic tires by what is known as the "air bag process." Patent 1566259. A. R. Colvin, c/o Combination Rubber Mfg. Co., Trenton, N. J.

RADIUS-ROD ASSEMBLAGE.—So constructed that provision is made for a ready renewal of one or more of the rods should occasion require. Patent 1566207. L. H. Griggs, 621 W. Jefferson St., Mishawak, Ind.

TRACTOR-OPERATED CULTIVATOR.—Constructed so that the tractor is back of the cultivator and pushes the same, enabling the operator to readily see the crop. Patent 1566229. G. H. Scanlan, c/o J. A. Sheehan, 44 Court St., Brooklyn, N. Y.

Designs

DESIGN FOR A TEXTILE FABRIC.—This inventor has been granted four patents for fabric designs. Patents 68666, 68667, 68668, and 68669. I. Strauss, c/o Rosenstein Strauss Corp., 151 W. 36th St., New York, N. Y.

DESIGN FOR LEATHER OR SIMILAR ARTICLE.—Patent 68813. F. A. Kolb, c/o Geisman, Musliner & Brightman, 27 Spruce St., New York, N. Y.

DESIGN FOR A HAND-BAG FRAME.—Patent 68853. W. F. Goldsmith, 391 Mulberry St., Newark, N. J.

DESIGN FOR A HAND-BAG FRAME.—The inventor has been granted two patents, Nos. 68906 and 68907. W. T. Goldsmith, 391 Mulbury St., Newark, N. J.

DESIGN FOR A BOUDOIR CAP.—Patent 68,884. W. J. Turoff and E. A. Besancon, 1076 Intervale Ave., Bronx, N. Y.

DESIGN FOR AN EMBLEMATIC PIN.—Patent 68847. N. L. Bourgeault, c/o Ross Bros., San Francisco, Calif.

DESIGN FOR A STATUETTE.—Patent 68598. Irene H. Rundquist, 4807 First Ave., Los Angeles, Calif.

DESIGN FOR A LIGHTING FIXTURE.—Patent 69015. E. J. Dietzmann, 834 So. Figueroa St., Los Angeles, Calif.

DESIGN FOR A DISPENSING CABINET OR SIMILAR ARTICLE.—Patent 69092. R. A. Norton, 606 W. 116th St., New York, N. Y.

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